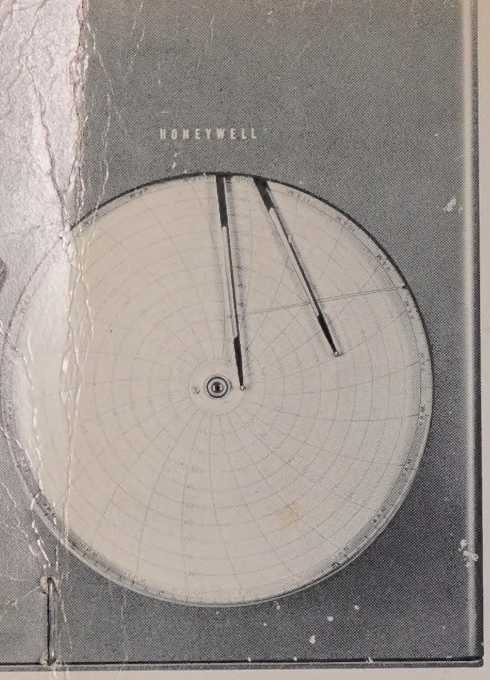

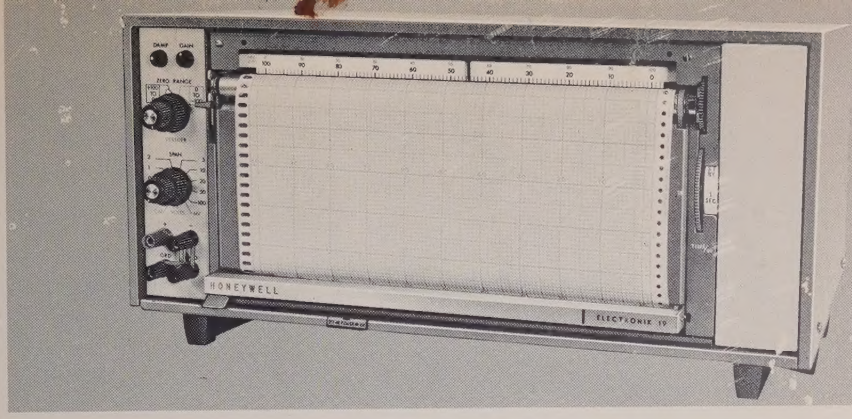

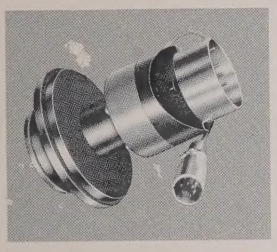

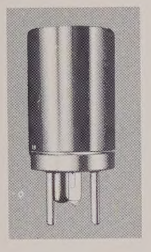

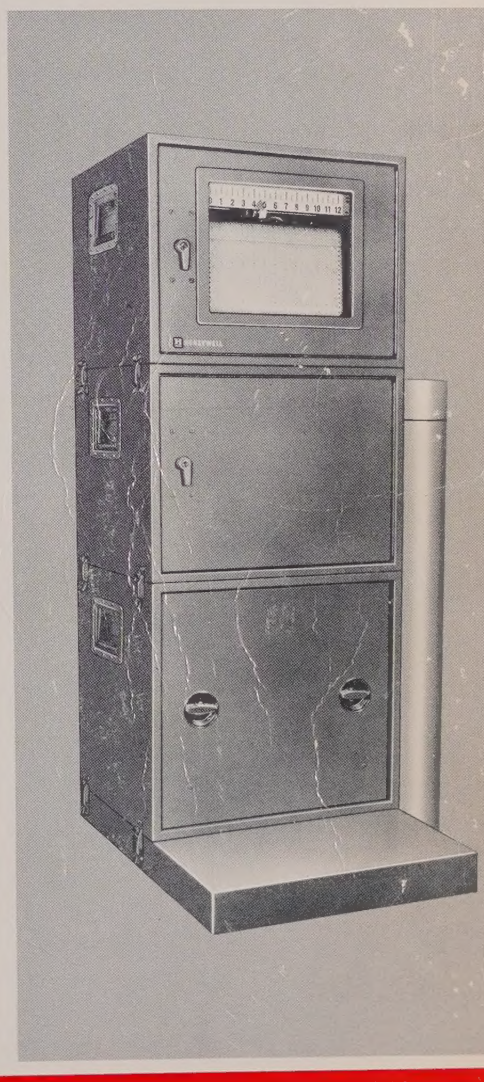

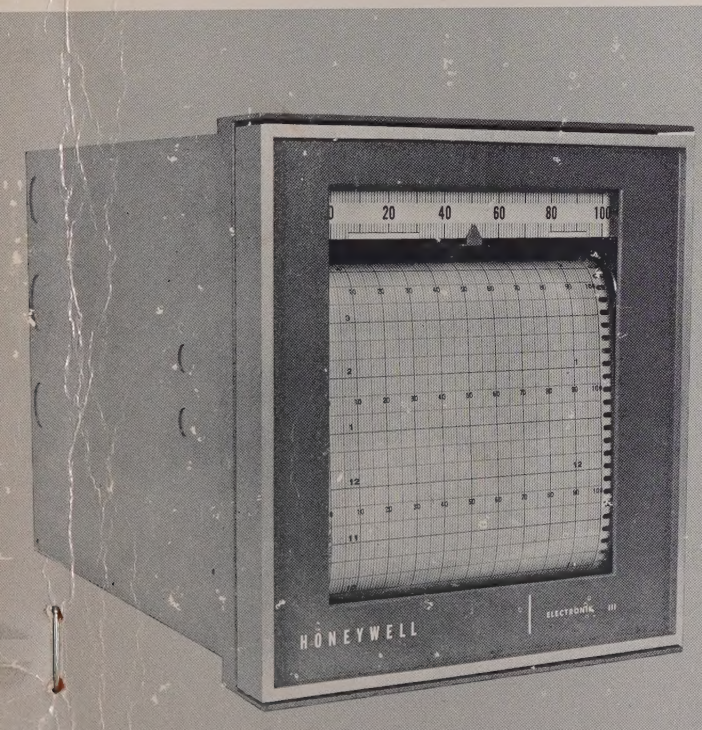

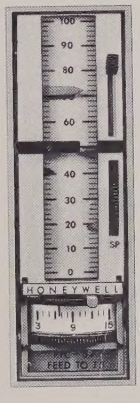

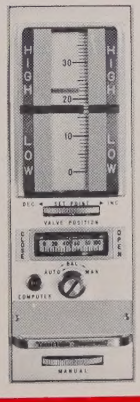

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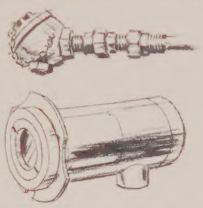
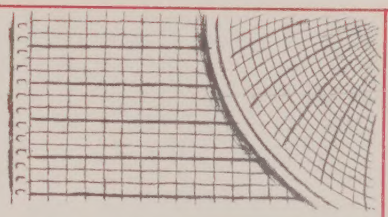
HONEYWELL

INSTRUCTIONS

Honeywell Instrumentation and Systems for Measurement and Control

Honeywell's Industrial Division offers a broad array of instrumentation and systems for measurement and control. On the inside covers of this instruction manual you will get some idea of the product and service capabilities offered by this division. You won't find complete lines or all the latest products in any given line. To order any literature concerning any of the products shown or mentioned within the various functional breakdowns, write Honeywell, Industrial Division, Fort Washington, Pa. 19034 or contact your nearest Honeywell branch office.

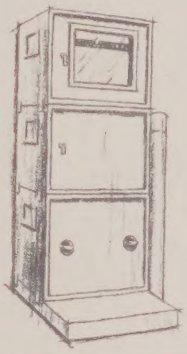




PRIMARY DEVICES AND ACCESSORIES

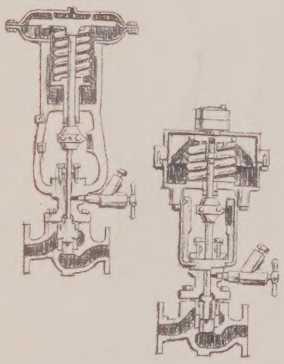
Thermocouple assemblies (over 100 to choose from) meeting virtually every scientific and industrial requirement. Radiamatic Detectors are available in six basic models, with a complete line of accessories, and support and mounting hardware.

Honeywell can provide any type of chart that you require—regardless of size, range, graduations, and special specifications. A Honeywell chart is accurate, clean, smooth, bright, and dimensionally stable—the best chart you can buy.



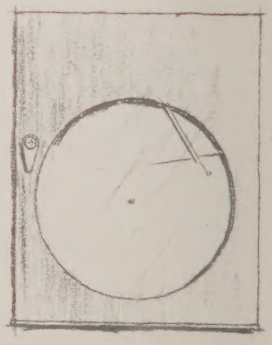
WATER QUALITY INSTRUMENTATION

Honeywell offers an established line of sensors and complete data collection systems. This equipment can be used to provide continuous, accurate water quality data in a number of forms to aid in monitoring and controlling the condition of plant influent and effluent.



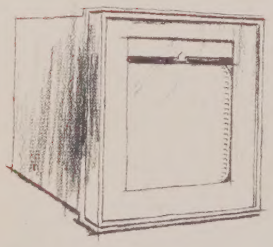
CONTROL VALVES AND ACTUATORS

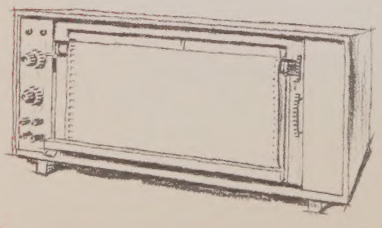
Only one of a wide line of valves available, Honeywell's cage valves provide extra long life and ease of replacing the valve trim. It is a simple one-man operation to remove the actuator, lift out the old plug, cage and gaskets, and insert the new plug and gaskets. Type 01 pneumatic diaphragm-actuated actuators can be either direct or reverse acting, spring or springless. Type 05 can be direct or reverse acting with enclosed spring. Both actuators are available with single and double seated valves.



THERMOMETERS

Honeywell filled-system thermometers come in a variety of indicators, recorders, or controllers. The thermal systems of these thermometers are divided into three classes by fill material: vapor, gas, and mercury. Thermometers are available as circular chart recorders with one, two, or three pens, eccentric scale indicators and, with pneumatic or electric control. *Servoline* electronic thermometers fill the gap between fiilled-system thermometers and potentiometric recorders. Adjusted by resistance bulbs, these thermometers measure temperatures from cryogenic regions to +1500°F using only one instrument, one measuring element, and with accuracies of up to 2/10°F. The bulb is connected to the instrument by a three-wire cable.

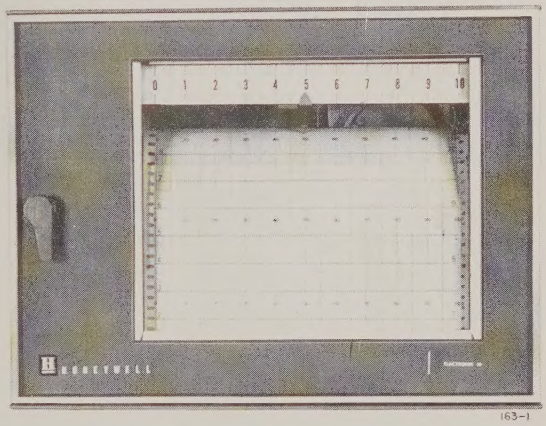




ElectroniK INSTRUMENTS

Electronik Instruments are available as strip chart, circular chart, precision indicators with or without control, or Lab/Test Recorders. These versatile instruments fill the needs of industrial or laboratory process measurement and control. They can be used for exact measurement of such physical quantities as temperature, pressure, vacuum, flow, millivolts, voltage, power, frequency, force, torque, speed, humidity, moisture, pH, viscosity, color and others that can be converted into an electrical signal.

Instruction Manual
*ElectroniK 16**
Strip Chart Recorder



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* *Tradename - HONEYWELL INC.*

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TWO-SPEED GEAR REDUCTION UNIT 758-1

INSTRUMENT **DESCRIPTION**

1. GENERAL

a. The ElectroniK 16* Strip Chart Recorder is a continuous balance servo potentiometer. Used in conjunction with many types of primary elements, it automatically measures the magnitude of a variable by comparing the input signal from the primary element with a feedback signal from the measuring circuit; it responds to input changes by rebalancing. The measured variable's value is recorded on calibrated 11-inch strip chart paper which is automatically rerolled to provide a permanent record.

b. The instrument's physical and design characteristics meet or exceed those specified in ASA #39.4-1956. Its compatibility with a variety of primary elements and its many optional features make the instrument flexible for use in laboratory applications.

2. SPECIFICATIONS

a. To assure optimum performance, we recommend maintaining supply voltages between 107 and 127 volts ac. The instrument will function even if supply voltages reach extremes of 100 or 130 volts ac.

b. Instruments designed for a nominal frequency of 60 cps will accept variations from 58 to 62 cps; they will tolerate extremes of 56 or 64 cps. Variations from a 50 cps nominal frequency should be within 48 to 52 cps (46 or 54 cps extreme).

c. Recommended ambient temperature limits at the instrument location are 59 to 105° F; however, extreme temperatures of 15 or 125° F can be tolerated.

d. Calibrated accuracy for all millivolt spans is $\pm$ 0.25% of span; for compensated actuations it is $\pm$(0.25% of span + 1/4° C).

e. Standard instruments are designed for operation with source resistance from 0 to 10,000 ohms. (Higher limits are available).

f. Instrument deadband for any span will not exceed 0.1% of full scale span, under reference conditions.

g. Maximum suppression, available on standard instruments, is twice the instrument span. (Higher limits are available.)

h. Span step response time is the time required for the indicator carriage to travel from 0% to 100% full scale, and balance within the instrument's rated accuracy, in response to a step change in input voltage equal to the instrument span. The nominal span step response time rating is the maximum time required to achieve balance with normal mechanical loading of the servo system. Nominal response times available are 15, 5, and 1 seconds with 60 cps operation; 18, 6, and 1.2 seconds with 50 cps operation.

* *Honeywell Trademark*

CHASSIS **DESCRIPTION**

1. GENERAL

a. The instrument's die-cast aluminum chassis (figures 1 and 2) supports all the components of the display, and rebalancing system.

b. The chassis slides on channel tracks. All instrument components are easily accessible; you merely lift the chassis release latch, which is also a handle, 90° into the horizontal plane, and slide the entire chassis out of the enclosure. Stops allow the chassis to be extended partially (for operating maintenance) or fully (for service). To remove the chassis from the case, disconnect a single electrical plug connection and manually override the mechanical chassis stops.

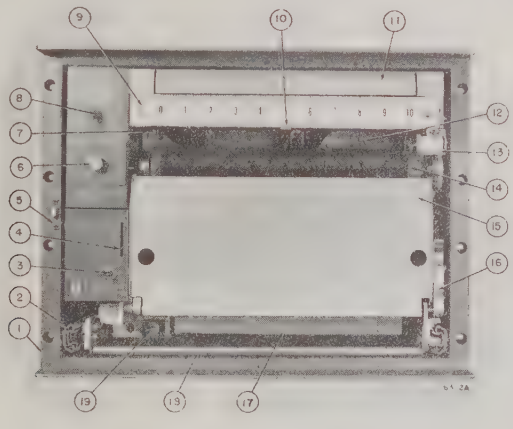

Figure 1. Instrument, door removed

LEGEND

1. Case
2. Channel track
3. Chart switch
4. Chart supply indicator (optional)
5. Door catch
6. Ink compartment
7. Ink delivery tube
8. Pen lifter (optional)
9. Scale
10. Indicator and recording carriage
11. Chassis dust cover
12. Drive cable drum
13. Event marker pen (optional)
14. Chart drum
15. Chart tearoff groove
16. Chart housing release latch
17. Servo circuit unit
18. Chassis release latch
19. Power switch

2. SYSTEMS

a. The servo system includes all the components that translate the error signal into an indication of the value of the process variable; these include:

.... the balancing motor, which develops the torque to reposition the measuring slidewire and the indicator carriage,

.... the drive cable, which translates the rotary motion of the motor to a lateral motion of the indicator carriage,

.... the indicator and recording carriage, which indicates the variable's magnitude on the calibrated scale while the print mechanism records that value on the chart,

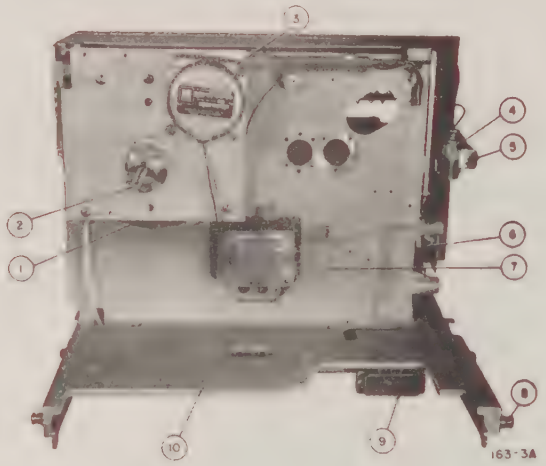

Figure 2. Instrument Chassis, removed from case

LEGEND

1. Drive gear
2. Servo drive shaft
3. Balance motor
4. Ink reservoir (optional event marker pen)
5. Ink compartment
6. Chart drive motor
7. Power transformer (amplifier)
8. Guide bearing
9. Connector
10. Instrument chassis

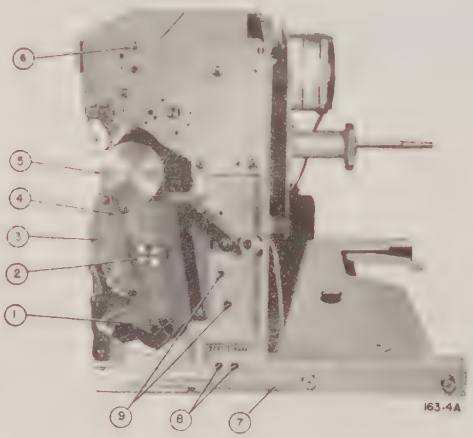

Figure 3. Instrument Chassis, right-hand view

LEGEND

1. Chart reroll knob
2. Chart supply knob
3. Chart carriage
4. Reroll drive spring
5. Chart advance knob
6. Dust cover retaining screw
7. Chassis stop
8. Adjustors (measuring circuit)
9. Adjustors (amplifier)

.... the amplifier circuit, which converts the d-c error signal into an a-c signal and amplifies that signal to drive the balancing motor.

b. The display system includes recording and indicating components such as: chart, chart carriage, indicator carriage, recording device, calibrated scale, and the chart drive and reroll system (figure 3). A variety of optional features are available, including the chart supply indicator shown in the illustrations. Procedures for installing the chart and for placing the recording device in operation, are included later in this manual. The remote ink reservoirs are located on the left-hand side of the chassis in a pull-out drawer-type compartment (figure 4).

LEGEND

1. Ink delivery tubes
2. Pen lifter mechanism
3. Chart drive mechanism
4. Ink reservoir (recording pen)

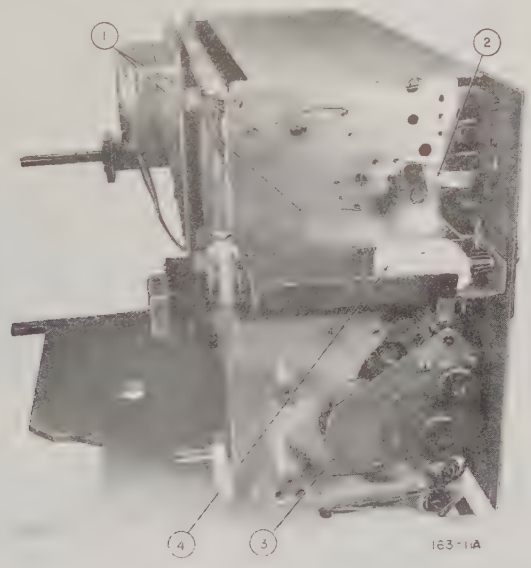

Figure 4. Instrument Chassis, left-hand view

3. AUXILIARY SWITCHES

a. Auxiliary MICRO SWITCH* units for alarm or signalling can be supplied as an optional feature on this instrument; they mount on the rear of the chassis assembly and are adjusted from the back of the chassis (backset design).

b. Auxiliary switches are illustrated in a separate section which is included (later in this manual) when this equipment is supplied.

**Honeywell Trademark*

4. SERVO CIRCUIT UNIT

The servo circuit unit (figure 5) is mounted to, but insulated from, the instrument chassis. The unit consists of printed circuit panels for the amplifier, measuring circuit, and constant voltage circuit. These are completely enclosed by a housing and cover plate which are part of the Faraday shield used to overcome common mode stray noise.

CAUTION: The servo circuit unit may be at a relatively high potential, (dependent on operating conditions), since the input potential and common mode stray potential are both present on the instrument shield. Refer to the discussion of shield connections in the installation procedures before touching or attempting to remove the cover plate of the servo circuit unit.

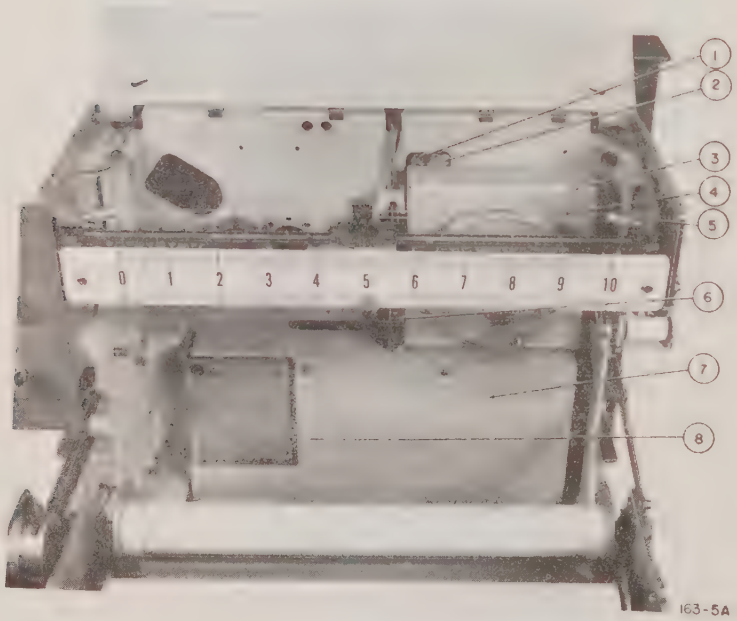

Figure 5. Servo components

LEGEND

1. Servo motor pinion
2. Drive gear
3. Slidewire cover
4. Drive cable
5. Guide Pulleys
6. Terminal block (amp.-mtr.)
7. Servo circuit unit
8. Power transistor heat sink

ENCLOSURE DESCRIPTION

1. CASE

a. The instrument is housed in a dust and moisture-resistant steel case suitable for relay rack, panel, or bench mounting. External dimensions of the case are specified on a separate diagram included in this manual.

b. The exterior finish will resist normal industrial atmospheres. Steel channel tracks, which support the chassis and permit its removal, are mounted to the sides of the case.

c. All connections, including those for power and primary elements are made externally (from the back) to the terminal panel (figure 1) via knockouts in the case. The input panel also includes the compensation block for the thermocouple reference junction (when applicable). A metal cover protects all connections when the instrument is in service.

2. DOOR

a. You can quickly remove the door to expedite servicing, by merely lifting the release latch located in the door assembly at the upper hinge pivot.

b. The door assembly includes the hinge pivots, door glass, gaskets, masking strips, door latch and (optional) integral lock assembly.

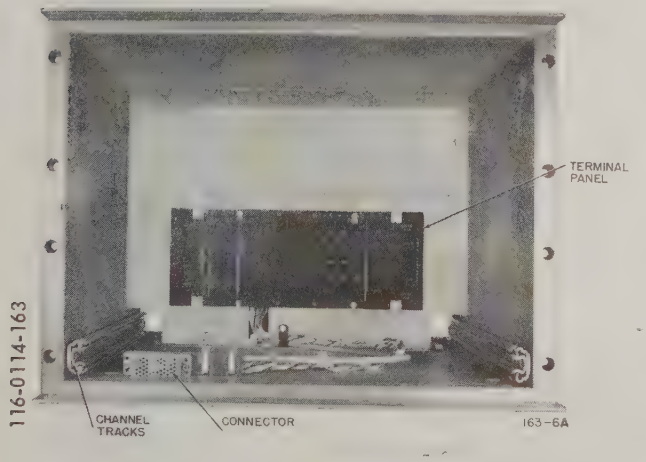

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Figure 1. Case interior.

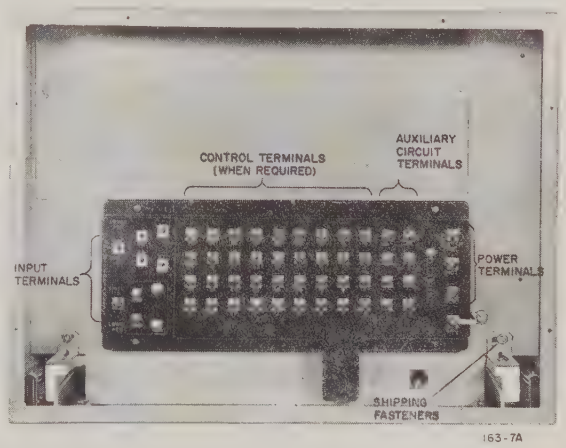


Figure 2. Terminal compartment.

MEASURING CIRCUIT — DESCRIPTION

1. GENERAL

a. A printed circuit board type measuring circuit is supplied in this instrument. The range card can be easily removed and replaced by another card to provide the required range and actuation.

b. Since easy and convenient conversion is a basic feature of this design, all standard measuring circuits are covered in this section.

c. The range card, housed in the servo circuit unit on the instrument chassis, includes most measuring circuit components. For thermocouple actuations, a reference junction compensation block is mounted on the input terminal panel. Clearly identified terminals are provided for connections from the input terminal panel, from the constant voltage circuit, and to the rebalancing element.

d. Electrical span and zero adjustors are mounted on the range card: each can be adjusted via access holes provided in the side of the instrument chassis. Both adjustors have a 100-turn full scale adjustment which is equivalent to a 40% full scale span adjustment and 60% full scale zero adjustment.

e. The measuring circuit uses precision manganin range resistors wound on plastic spools, and mounted directly to the range card. Composition type resistors are used in non-critical locations (the optional burnout resistors).

2. CIRCUIT

a. The measuring circuits, are variations of the standard potentiometric circuit.

b. The physical appearance of the measuring circuit will vary, depending on the circuit configuration, for each instrument range and actuation. The basic circuit is modified as necessary to provide all actuations. Each available circuit is described and shown schematically in the Theory section for the measuring circuit.

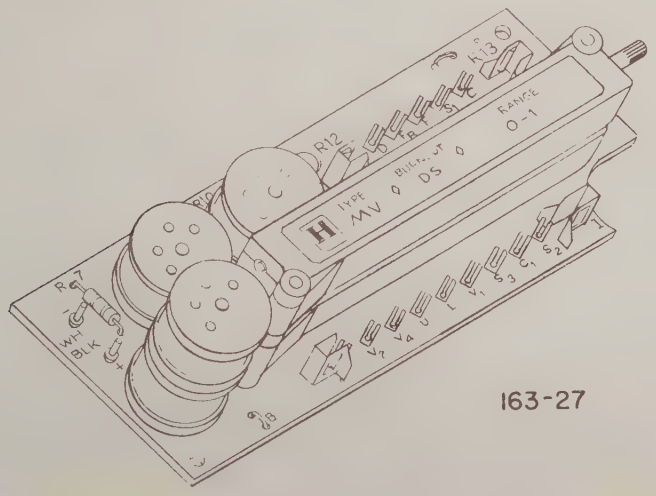


Figure 1. Typical Range Card

CONSTANT VOLTAGE CIRCUIT — DESCRIPTION

1. PURPOSE AND USE

The constant voltage circuit develops and maintains a stable output voltage across the measuring circuit, and causes a steady current to flow through that circuit. Current distribution within the measuring circuit is determined by the resistance ratios of the circuit branches. A stable current passing through the calibrated slidewire is necessary to maintain the rated accuracy of instrument measurements.

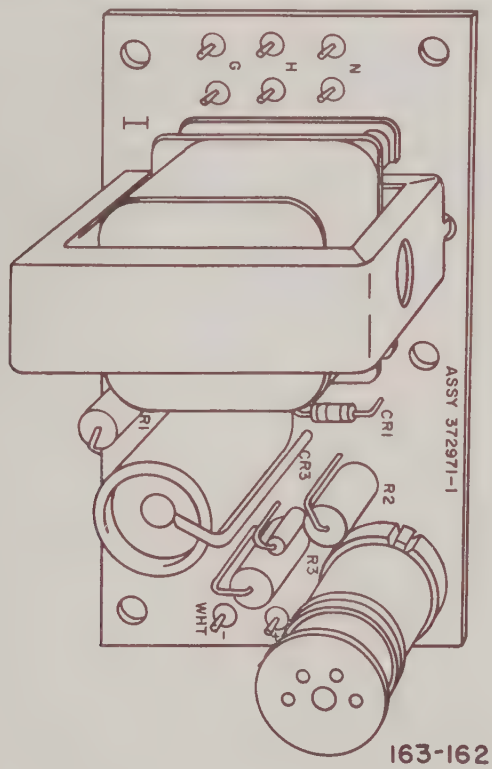


Figure 1. Constant Voltage Circuit.

2. PERFORMANCE

a. The constant voltage circuit is a precision d-c power supply. It uses a diode rectifier and filter circuit to convert ac from the power transformer to the dc required by the measuring circuit. This is followed by cascaded zener diode voltage regulation stages which provide high output voltage stability with line voltage variations. A copper resistor in the output circuit compensate for the temperature coefficient of the second stage zener diode, providing high output stability with ambient temperature variations.

b. With the constant voltage circuit connected to a constant resistive load, the output voltage will be virtually unaffected by variations in either line voltage or ambient temperature within the stated limits.

c. The output can be opened or shorted without causing any damage to the device.

3. ACCURACY

a. With any combination of a +10 to -20 volt variation, from a 120 volt supply, and a ±55°F variation, from a reference temperature of 85°F, the output voltage with rated resistive load will remain constant within ±0.15%

b. The output voltage will remain within ±0.03% if the 120 volt supply changes by ±10 volts; within ±0.04% for a -20 volt variation.

c. Calibrated accuracy of the output voltage with rated resistive load and under reference conditions of 85°F and 120 volts ac is ±0.08%.

NOTE: When the constant voltage circuit is not in use, storage temperatures between -60°F and +160°F can be tolerated without damage to the unit.

1. PURPOSE AND USE

a. The transistor type amplifier receives an error signal which is the difference between the input signal and the measuring circuit feedback signal. This error signal is converted to a.c. and amplified to drive the servo motor.

b. The magnitude and phase relationship between the error signal and the amplifier's output (drive signal) determine the starting torque, speed and the direction of drive of the servo motor.

2. COMPONENTS

a. **GENERAL.** All segments of the transistor type amplifier are individual printed circuit panels. These are mounted and electrically interconnected within the servo circuit unit (figure 1).

Figure 1. Typical Location of Amplifier Assembly

b. **INPUT PANEL.** This assembly contains the filter, input transformer, chopper, and adjustors for gain (sensitivity) and damping. Input connections are made through a five-terminal connector on the measuring circuit panel. The output is connected to the main amplifier board through a set of twisted wires (soldered to pin terminals). A single two-wire shielded cable connects the gain control to the main amplifier board.

c. **VOLTAGE AMPLIFIER PANEL.** The stages of voltage amplification are located on this printed circuit board.

d. **POWER AMPLIFIER PANEL.** This assembly consists of the interstage transformer (T3), the output stage biasing components, and servo motor phasing capacitors (C13 & C14). Inter-connection terminals facilitate connecting the power transformer (T1) and the five-wire output cable.

e. **HEAT SINK ASSEMBLY.** The power output transistor, is mounted on an aluminum heat sink.

SLIDEWIRE **DESCRIPTION**

1. GENERAL

The pancake type slidewire assembly, shown in figure 1, is mounted on the front of instrument chassis. The slidewire wiper arm is mounted on the back surface of the drive cable drum. The entire slidewire and contact assembly is protected from dust and accidental damage by a snap-off cover which is part of the measuring circuit shield.

2. CONSTRUCTION

a. The slidewire assembly consists of a molded circular form on which are mounted two resistance windings (1600 turns of manganin wire). One winding develops a calibrated emf along its active length; the other winding is shorted to the copper mandrel and hence has no potential difference across it. Feedback voltage is developed across the active winding; the shorted winding serves as the collector.

b. Connections between the slidewire and measuring circuit panel are made through a three-wire shielded cable. Quick disconnect push-on terminals are provided on the color coded wires at the slidewire.

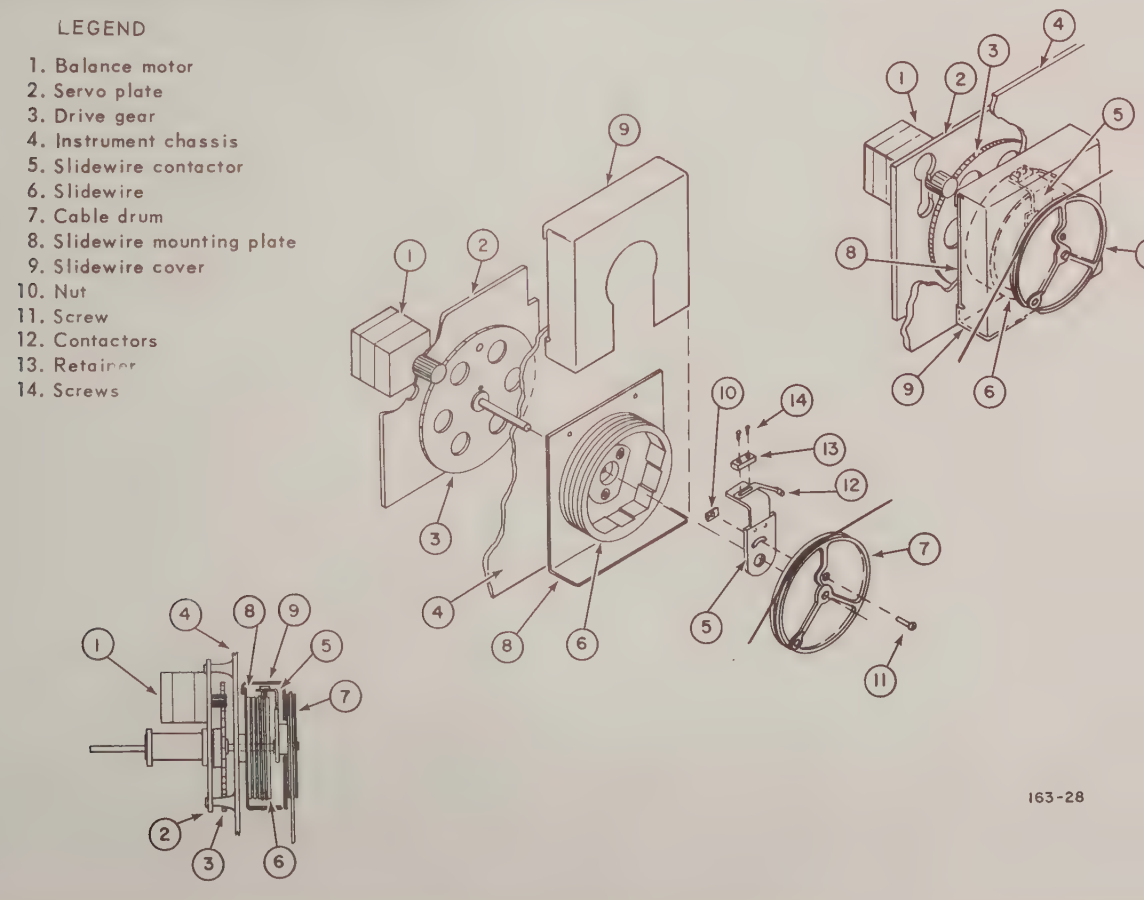


Figure 1. Slidewire assembly and drive system.

SINGLE-SPEED CHART DRIVE — DESCRIPTION

1. GENERAL

A synchronous motor drives the chart drum through a gear train, moving the chart at the basic rate specified in the order and indicated on the instrument nameplate. Speed-change gears, supplied as standard equipment, can be used in place of two gears in the train to produce a chart rate of either twice or half the basic rate. The speed-change gears are installed at the factory when specified. Gears not in use are fastened to the gear plate assembly.

2. CHANGING CHART SPEED

a. Remove the two knurled nuts (figure 1) and remove gears A and B.

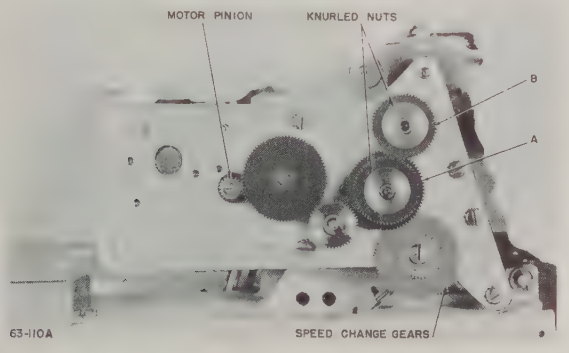


Figure 1. Single-speed chart drive mechanism, one inch per minute basic rate or faster.

b. Remove the screw holding the speed-change gears and secure the gears removed in step a to the plate, using the same screw.

c. Install the speed-change gears on the hubs as follows:

(1) For twice the basic speed place the larger gear on driving hub A and the smaller gear on driven hub B.

(2) For half the basic speed place the smaller gear on driving hub A and the larger gear on driven hub B.

3. REPLACING MOTOR

a. Disconnect motor leads.

b. Remove two nuts, two screws, and two lockwashers that mount the motor, and remove the motor. Mention the part number (on motor nameplate) when ordering a replacement motor.

c. Mount the new motor with the screws, lockwashers, and nuts provided.

d. Refer to the wiring diagram when replacing motor leads.

NOTE: The instrument can be equipped with an electrically operated two-speed drive. When the two-speed unit is installed, it is described in a separate instruction section.

TWO-SPEED GEAR REDUCTION UNIT — DESCRIPTION

1. GENERAL

a. The two-speed chart drive (figure 1) is a gear reduction unit installed between the drive motor pinion and the first gear of the drive train. The two-speed unit can be used with a single-speed gear train using the large high-torque motor or with the four-speed gear train. Features of the basic chart drive, such as speed-change gears in the single-speed unit or the manual speed changer of the four-speed drive are unaffected.

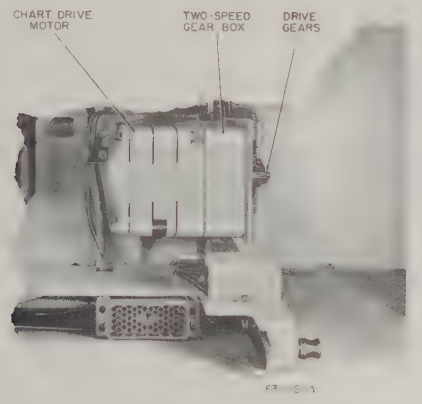


Figure 1. Rear of chassis, showing two-speed gear box (insert shows switch on front panel).

b. Speed reduction ratios of 2:1, 3-1/3:1, 6:1, 10:1, 30:1, and 60:1 are available. Gear boxes are interchangeable and can be installed in the field by removing the chart drive motor, bolting the gear box in place, and re-installing the drive motor.

c. Chart speed is electrically controlled by a three-position switch on the front of the chassis (see insert, figure 1). The OFF position turns off the chart drive motor; HI is the basic chart speed; the LO position reduces chart speed to one of the ratios in paragraph b. Change gears on the single-speed chart drive can be used to double or halve either of the speeds produced by the two-speed drive. The selector of the four-speed drive can be used to multiply either the HI or the LO output of the two-speed unit by one, two, four, or eight, producing a total of eight different speeds.

2. OPERATION

a. The two-speed drive unit has two gear trains, a single gear between the motor pinion and the gear box output pinion, producing the basic or HI speed, and a train of two gears (2:1, 3-1/3:1, or 6:1 reduction) or four gears (10:1, 30:1, or 60:1) for the LO speed (figure 2). Both sets of gears are in constant mesh with the chart drive motor pinion and the gear box output pinion, which drives the first gear of the chart drive mechanism. Only one set of gears can drive the output pinion at a time. Two overrunning clutches in the two-piece hub of the output pinion limit its rotation to one direction (clockwise) and permit the idle gear train to run free.

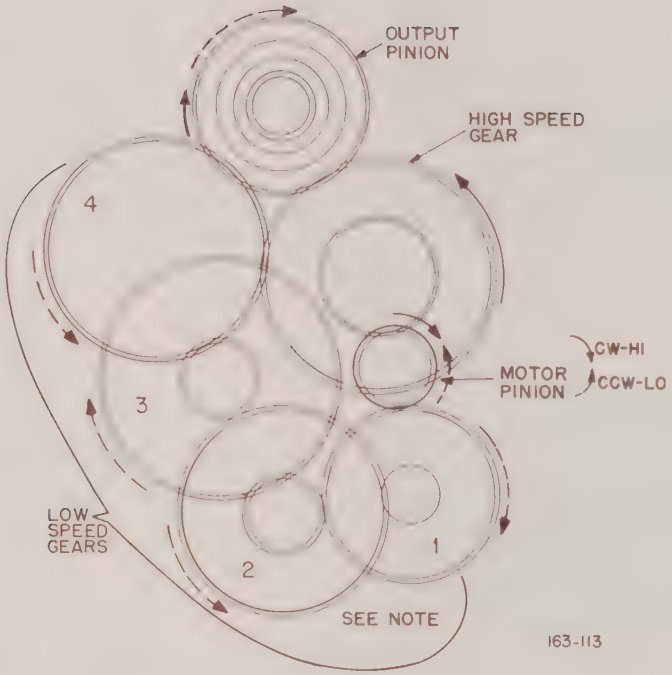


Figure 2. Two-speed chart drive mechanism.
NOTE: Configuration shown is for 10:1, 30:1, or 60:1 reduction. Gears 1 and 2 are not used on 2:1, 3-1/3:1, or 6:1 gear box; motor pinion meshes with gear 3.

b. When the motor pinion is turning clockwise, drive is through the single high-speed gear (solid arrows) driving the chart mechanism at its basic speed, while the clutch in the output hub permits the low-speed gears to free-wheel. When the chart motor is reversed electrically by the chart drive switch, phase-shifting current through its control winding, the motor pinion turns counterclockwise, operating the low-speed gear train (dashed arrows), while the high-speed gear free wheels. Note that the output pinion turns clockwise in both cases.

3. BASIC CHART DRIVE MECHANISM

a. When the two-speed drive is used with a single-speed mechanism, refer to the single-speed chart drive section for procedures such as changing speed-change gears and replacing the motor.

NOTE: The illustration in the single-speed section shows a high-speed drive (one inch per minute or faster). When a basic speed of 30 inches per hour or slower is required, additional gears are furnished.

b. When the two-speed gear box is used with a four-speed chart drive mechanism, refer to the instruction section on the four-speed drive for procedures associated with the motor and basic drive mechanism.

1. UNPACKING

a. The Electronik 16 Instrument is carefully packaged to protect it during shipment. Use reasonable care when removing the instrument from the protective container.

b. Place the shipping container on a flat surface preferably at bench height.

c. Unseal the carton. Remove the chart and accessory kit from the tray. Remove packing from the front of the instrument. Place the carton on its side with the instrument in the upright position, and slide it out of the container. For protection of the instrument, do not remove from polyethlene bag until ready to install in final location. Retain packing material for repacking, if required, at a later date.

d. If the instrument is supplied with the optional door lock, the key will be taped to the door glass. Turn the key clockwise to unlock the instrument, and rotate the door latch counterclockwise through 1/4-turn to unlatch the door. The door can then swing out 180° to the right.

e. Remove tape from chassis latch.

2. LOCATION

a. Locate the instrument as close as practicable to the measured variable(s). The location should be clean and dry and have a relatively stable temperature. Ambient temperature should be within the range recommended under instrument design specifications.

b. Allow sufficient clearance at the front of the instrument to permit observation of the measurements as well as elbow room for performing periodic maintenance procedures and infrequent servicing procedures. Front clearance must also permit full extension and removal of the entire chassis assembly. Allow clearance at the rear of the instrument to permit access to all external connections.

3. SHIPPING FASTENERS

Locate and reposition the shipping fasteners as follows:

a. STANDARD SHIPMENT

(1) Remove back cover plate (figure 1).

Figure 1. Removal of back cover.

(2) Remove the 8-32 screw that holds each shipping bracket to the chassis. Loosen the screw that holds the bracket to the back plate and raise bracket. Tighten this screw again. Shipping brackets can then be lowered and fastened again by adding two 8-32 screws if the instrument is to be reshipped.

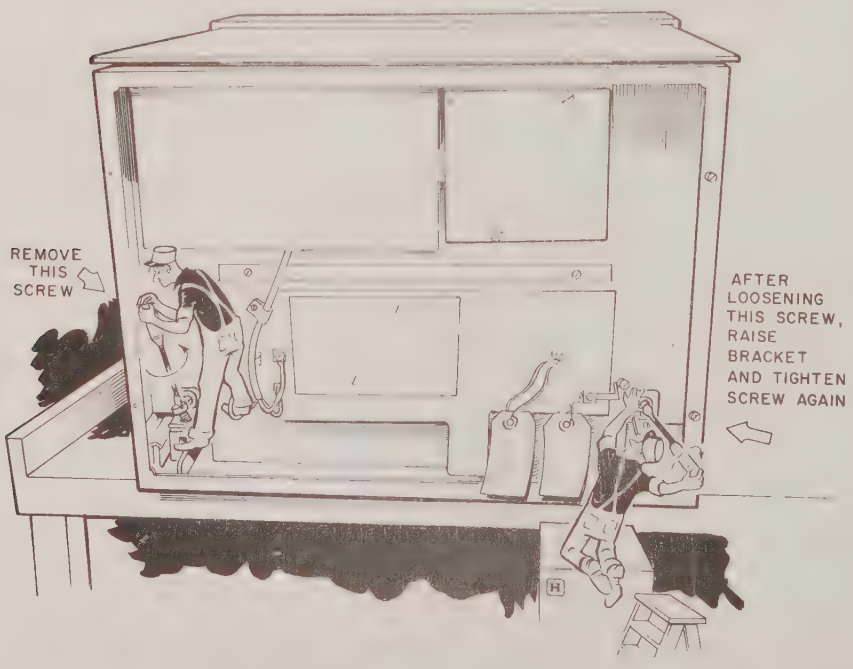


Figure 2. Repositioning shipping brackets.

(3) Slide chassis out to first stop then:

(a) Remove cardboard from the top.

(b) On pen dragging instruments, remove plastic tie which secures pen and untie manual pen lifter (if supplied). Remove tape from ink drawer. If remote pen lifter is supplied, remove rubber grommet(s) in pen lifter solenoid yoke(s).

(c) On multipoint instruments, untie print carriage and channel bar and remove block.

(4) For STRANDUCER information see paragraph 7e.
NOTE: The STRANDUCER is a sensitive piece of equipment and special care should be taken in following the instructions.

b. **SPLIT SHIPMENT** (Case and Chassis shipped separately)

(1) Case. Remove tape which secures connector plug and cable to case and remove tape from chassis slides. On multirecord instrument cases, unwrap and untie telescopic shaft.

(2) Chassis. Remove chassis from shipping board. Remove tape securing dust cover to side plate. Remove remaining tape and ties per paragraph (b) or (c) above.

4. MOUNTING

a. Dimensions of the enclosure are given on the diagram included in this manual. The accessory kit supplied with the instrument contains hardware for panel or relay rack mounting; laboratory feet accessories are supplied when bench mounting is specified. A panel cutout template is supplied when panel mounting is specified.

b. It is recommended that the chassis not be untied or have shipping fasteners repositioned until after installing the instrument. Should the occasion arise when it is necessary to remove the chassis before panel or relay rack mounting, special care should be taken to re-connect chassis connector plug P-3 and the selector switch telescope shaft when mounting is completed.

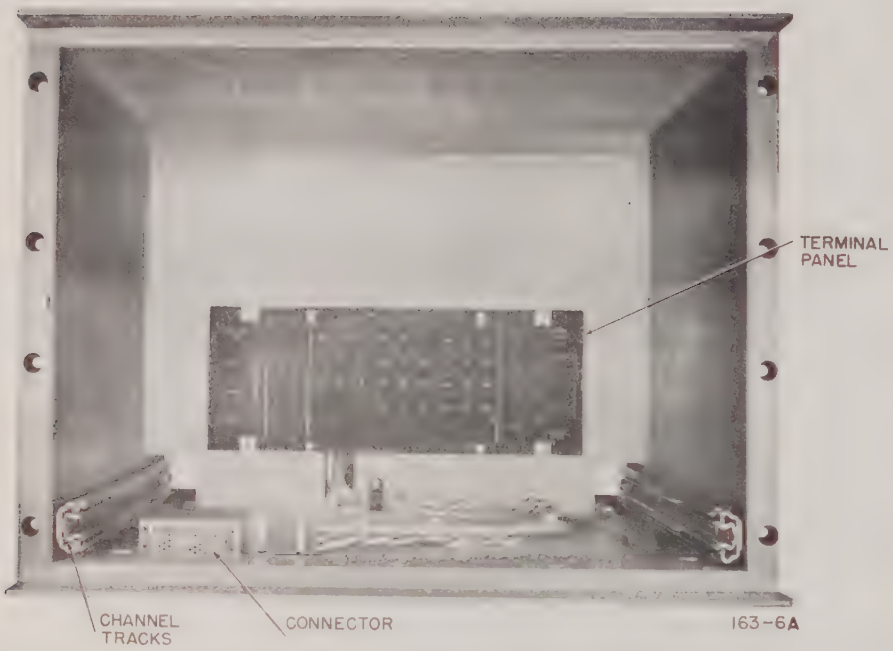


Figure 3. Inside of case.

NOTE: Shaft coupling is polarized. Rotate shaft until it seats properly and clamp closes in back of coupling.

c. If the instrument is mounted in a panel or relay rack, be sure to tighten all mounting bolts evenly to minimize strain on the instrument case.

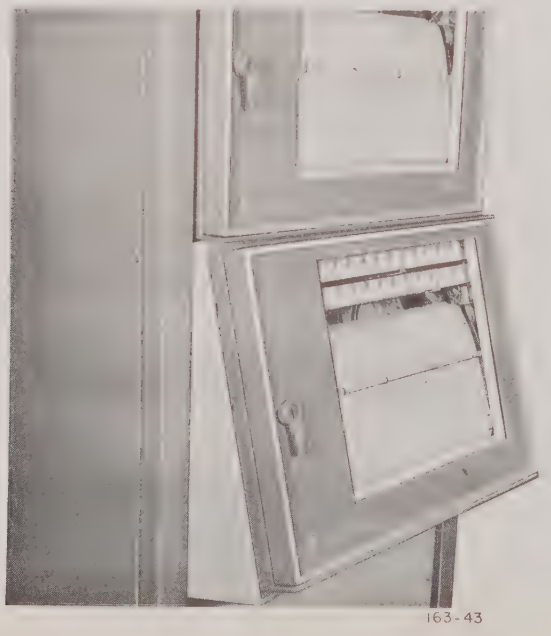


Figure 4. Instrument mounted -15° off normal.

d. While the instrument is commonly mounted in the vertical plane, it can be mounted up to ±10° off vertical without affecting instrument performance; the instrument will still operate at extreme positions of +15° and -45° (figure 4). The optional adjustable ink supply is required for non-vertical mounting of pen dragging instruments.

5. ELECTRICAL CONNECTIONS

a. All electrical connections are made to the input terminal panel shown in figure 5.

b. A separate wiring diagram, included in this manual, shows the required external connections. While this wiring diagram is self explanatory, the following terms deserve particular attention:

(1) Make all electrical connections to the terminals located on the back panel of the instrument. Each terminal is identified on the panel.

(2) Connect the instrument ground (GND) directly and separately to a known good ground, as recommended by the National Electrical Code. A cold water pipe is frequently an adequate ground; however, check the suitability of a particular water pipe before using it. If the pipe has a shallow location or uses fiber connectors, it may prove unsatisfactory. No. 14 B&S Gauge copper wire is recommended for the ground connection.

WARNING: Do not connect the instrument ground terminal to the neutral a-c line terminal.

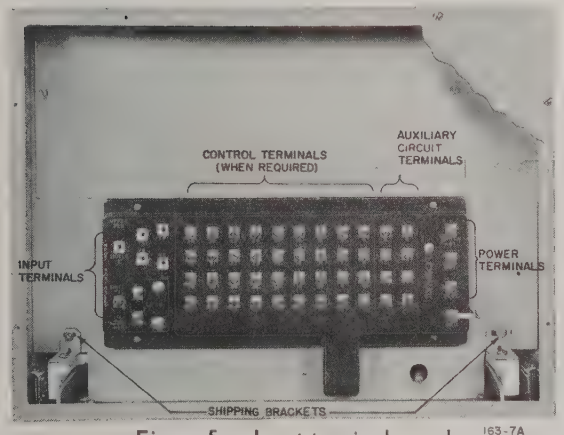


Figure 5a. Input terminal panel, pen dragging instrument.

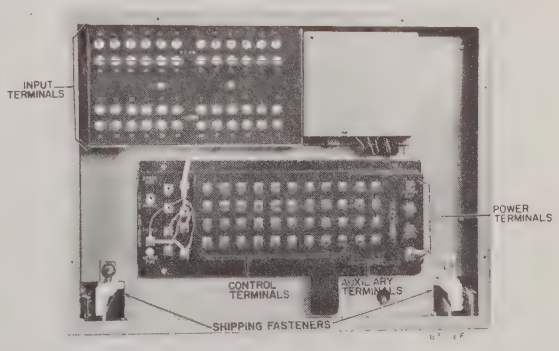


Figure 5b. Input terminal panel, multirecord instrument.

(3) Connect power leads as follows:

(a) Check the line to determine its neutral (grounded) side. (The neutral side of the line has the lower voltage between it and true ground.)

(b) Make connections to the HOT and NEUT. terminals on the panel assembly.

(c) Make electrical connections through knockout holes provided in the case. Knockouts are provided in the top, bottom and both sides of the terminal compartment for both 3/4 and 1" conduit connections. Select and open knockouts as required.

(d) If rigid conduit is used, make connections to the case with approximately 18 inches of flexible conduit to relieve strains on the instrument case.

(4) Install the primary element(s) and make connections as specified later in this manual.

(5) Replace cover plate on back of instrument.

6. OPTIONAL EQUIPMENT

Optional equipment may require additional electrical connections. If required, this information is included later in this manual.

7. RESHIPMENT PACKAGING

This instrument requires a "pre-shipment tie down" procedure which may vary slightly depending upon the particular model involved. The following description provides tie down information related to the indicated instrument types.

a. PRECAUTIONS

(1) Clean ink from pen(s) and tubing of instrument with remote ink supply:

(a) Place absorbent material under pen.

(b) Empty ink supply bottle and flush clean, then force ink from system.

(c) Remove bottle, fill with water, and attach again.

(d) Flush system until clean.

(e) Empty bottle again then attach and force water out of the system.

(f) Remove bottle, empty any water remaining, and re-insert. Check for snug leak-proof fit.

(g) Remove absorbent material.

(h) Remove all ink capsules from auxiliary pens.

(i) Close ink drawer (when supplied) and place a piece of masking tape over front.

(2) All pens and print wheels should be raised off the chart.

(3) Remove charts and reroll tubes.

(4) Tighten customer terminal panel screws to insure against loss.

(5) Insure that all internal connections, covers, screws, etc. are in place and tight. If any loose parts are left over, place in bag and tape bag securely in back of the chart module.

b. ALL INSTRUMENTS

(1) Turn the drive gear against the stop so that carriage or pen(s) is at extreme left of scale.

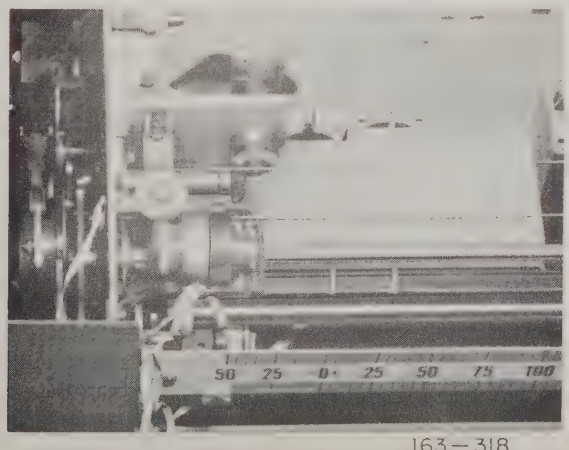
NOTE: In all references to plastic tie, tie should be snug but not tight enough to bend parts. Plastic tie part number is 366609-6.

c. MULTIPOINT

(1) Tie print carriage securely to left-hand side plate using available holes. Use plastic tie.

(2) Position Styrofoam block as shown in figure 6. Tie carriage channel bar to back place with plastic tie.

(3) Wrap plastic tie around print carriage and front channel. Feed through two holes in bracket and tie down.



163—318

Figure 6. Top of multipoint chassis, open.

d. SINGLE PEN

(1) Tie pen carriage to left-hand side plate using available holes. Use plastic tie.

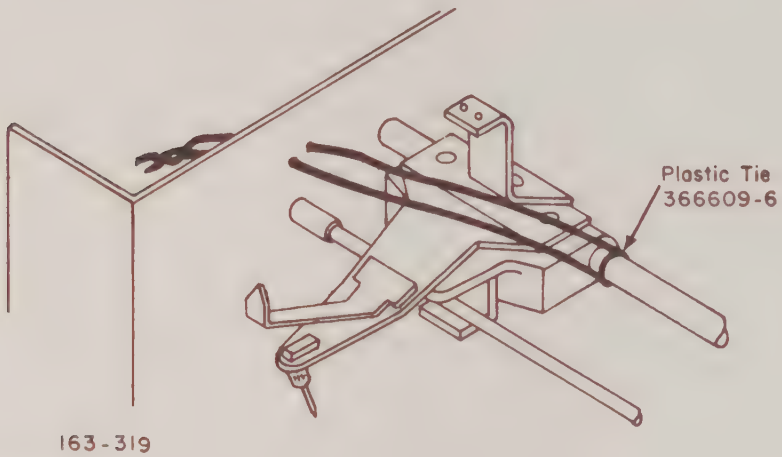


Figure 7. Single-Pen tie down.

e. TWO PEN

(1) Tie back pen carriage to left-hand side plate using available holes. Use plastic tie.

(2) Repeat (5) for front pen.

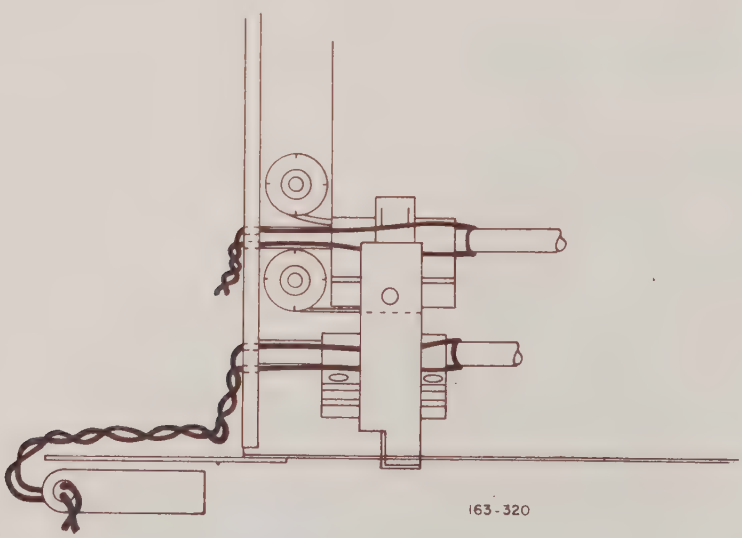


Figure 8. Two-Pen tie down.

f. STRANDUCER

(1) The units are always clamped in the downscale position (drive strap wound up).

(2) On multipoint, single pen, or lower pen of two pen instruments, a 5/16-inch long 6-32 screw (part number 6-605) is installed in STRANDUCER bracket, through the hole in cover of case.

(3) On the upper pen unit of a two pen instrument two turns of 1/4-inch tape is wrapped counterclockwise around hub of pulley on top of STRANDUCER case and the end is brought over the top and stuck to the cover of the case.

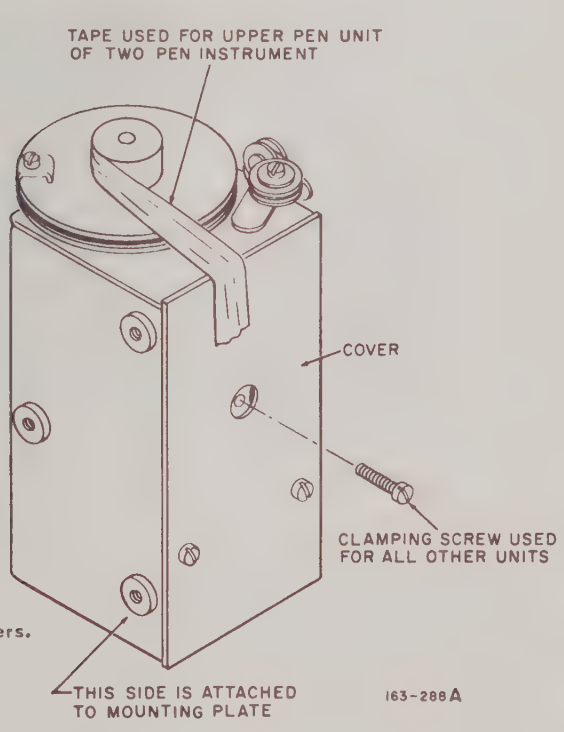


Figure 9. STRANDUCER shipping fasteners.

g. ALL INSTRUMENTS

(1) Close the chart transport.

h. TAPING (Masking Tape)

(1) Tape cardboard to tope of dust cover as shown in figure 10. Insure that two pieces of tape are used on each side as indicated.

(2) Slide chassis into case and tape chassis latch to bottom of case.

163-321

Figure 10. Top of Chassis, closed.

163-322

Figure 11. Chassis latch taped for reshipment.

i. CHASSIS LOCKING

Loosen the screws holding the shipping brackets and lower the brackets, until they rest on the chassis. They are then fastened to the chassis with one 8-32 round head screw, one plain washer and one #10 lockwasher.

NOTE: Bracket part number is 370710-1 and the screw that holds it on the back plate is an 8-32 round head.

j. ALL INSTRUMENTS

(1) Lock door and tape key to front of door.

(2) Replace back cover and insure that all screws are secure.

(3) Refer to packing diagram, included in this instruction for proper packaging. Supplies may be ordered or a suitable substitute may be used. Whenever possible, use same packaging that the instrument arrived in. Augment original packing material to compensate for compression due to shipment. Insure that new, strong tape is used as previously indicated.

NOTE: CUSTOMER SHOULD CHECK WITH NEAREST HONEYWELL BRANCH OFFICE, BEFORE SHIPPING, FOR ASSISTANCE IN PACKING TECHNIQUE AND MATERIAL.

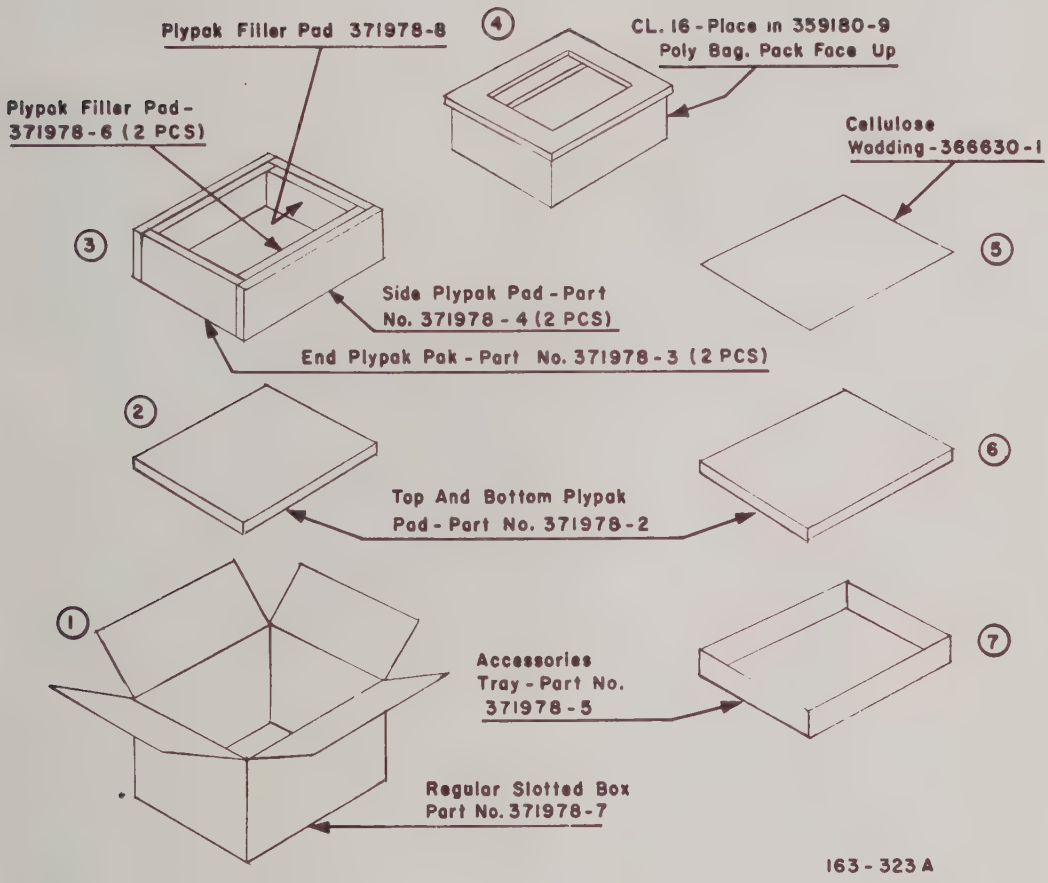

Plypak Filler Pad 371978-8
4
CL. 16 - Place in 359180-9 Poly Bag. Pack Face Up
Plypak Filler Pad - 371978-6 (2 PCS)
Cellulose Wadding - 366630-1
3
5
Side Plypak Pad - Part No. 371978 - 4 (2 PCS)
End Plypak Pak - Part No. 371978-3 (2 PCS)
2
6
Top And Bottom Plypak Pad - Part No. 371978-2
1
Accessories Tray - Part No. 371978-5
7
Regular Slotted Box Part No. 371978-7
163 - 323 A

Figure 12. Instrument packing order.

SHIELD **INSTALLATION**

1. GENERAL

a. For satisfactory performance the instrument shield must be connected to either the plus (+) (V_1) or minus (-) (V_3) input terminal (figure 1). This arrangement places the shield at a potential equal to the sum of the stray voltage plus the input signal, and prevents common mode (longitudinal) stray currents from passing through the measuring circuit and amplifier to ground. Figure 1 shows the shield arrangement supplied with the instrument when shipped. The shield includes the servo circuit unit and cover plate, and rebalancing element housing. Figure 2 shows the undesirable situation which would result if the shield jumper were accidentally omitted. Note that stray currents could flow to ground through the effective leakage capacitances C1 and C2. (Only typical capacitance locations are shown).

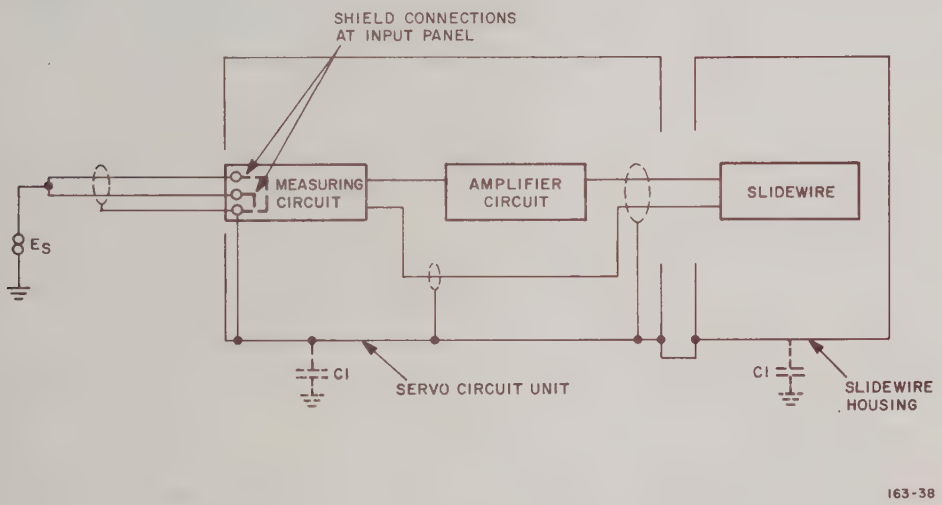


Figure 1. Instrument Shield

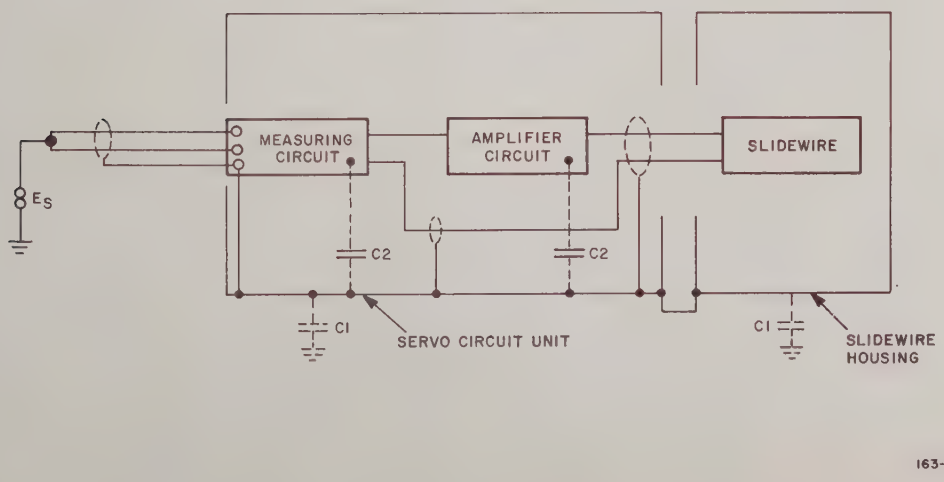


Figure 2. Effect of NOT Connecting Input to Shields

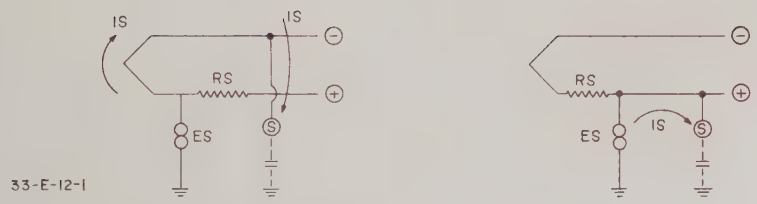
2. CONNECTIONS

a. The instrument is shipped with the shield jumper connected to the negative input terminal (V_3). This connection suffices for most primary element circuits; however, it's merely a typical connection and should be changed as necessary to improve instrument performance. The shield connection should eliminate or minimize the effects of voltage to ground stray pick-up. The specific connection is determined by the magnitude of the stray, with respect to the instrument span; the magnitude and distribution of the source impedance; and the location of stray signal injection by the source. In general, the instrument shield should always be connected to the primary element circuit lead which has the lowest impedance to ground to prevent passing current through the higher source impedance, as shown in figure 3.

b. In figure 4, various types of primary element circuits have been reduced to equivalent circuits (A, B, and C) which show the distribution of source impedance and the points at which the source might possibly be grounded. Determine the equivalent circuit for the primary element and connect the shield according to the data listed in Table 1.

TABLE 1
SHIELD CONNECTIONS FOR EQUIVALENT SOURCE CIRCUITS

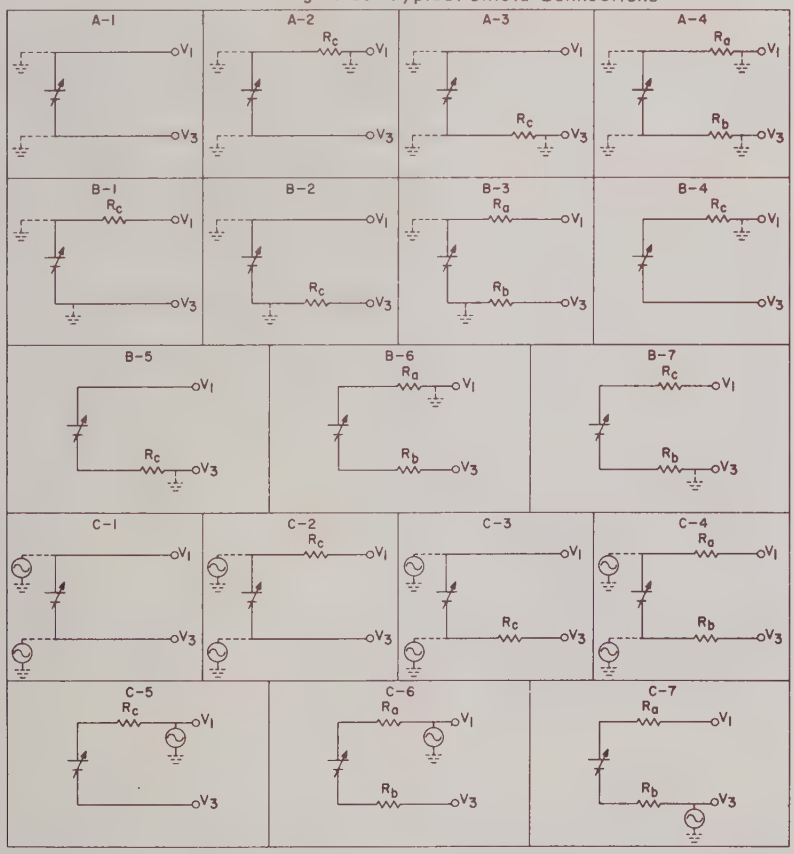
Magnitude of Stray to Ground	Total Source Impedance (R_c)	General Category	Specific Case	Shield Connection
Less than 1 volt per millivolt of span	Less than 1000 ohms	Type A circuits	All type A circuits	Connect shield to terminal
	1000 to 10000 ohms	Type B circuits	B_1,B_5,B_7; also B_3 if R_a is equal to or much greater than R_b	Connect shield to terminal V_3
			B_2,B_4,B_6; also B_3 if R_b is greater than R_a	Connect shield to terminal V_1
Greater than 1 volt per millivolt of span	0 to 10000 ohms	Type C circuits	C_1,C_2,C_7; also C_4 if R_b is less than 100 ohms and if R_b is less than R_a	Connect shield to terminal V_3.
			C_3,C_5,C_6; also C_4 if R_b is less than 100 ohms and if R_a is less than R_b	Connect shield to terminal V_1.
			C_4 if both R_a and R_b are high (above 100 ohms)	Enclose the input leads in a shielded cable and connect the shield lead to the SHIELD connection on the terminal panel.



⊖ NEGATIVE INPUT TERMINAL
⊕ POSITIVE INPUT TERMINAL
Ⓢ SHIELD TERMINAL

RS SOURCE IMPEDANCE
IS STRAY CURRENT
ES STRAY SOURCE

Figure 3. Typical Shield Connections



Legend of Symbols

	Variable Voltage, no a-c source to ground
	Variable Voltage, a-c source to ground
R_c	Customer's total source impedance or resistance, unilateral distribution
$R_a + R_b$	Equal to (R_c) customer's total source impedance or resistance. R_a and R_b may be equal or unequal. Equal distribution is of greatest significance in equivalent circuit C_4
V_1 and V_3	Instrument terminals, V_1 (+); V_3 (−)

Figure 4. Equivalent Source Circuits, schematic diagram

1. PLACING IN OPERATION

a. Check that all connections are as specified in the installation diagrams.

b. Switch on instrument power and allow the instrument to warm up for at least 30 minutes (2 hours for highest accuracy on thermocouple actuations) to stabilize internal temperature and be sure the measurements obtained are within the calibrated accuracy of the instrument. Switch on power to the chart drive system when recording is required.

c. If required by the application, remove the instrument door as follows:

(1) Swing door open.

CAUTION: The door comes off quickly, so have a firm grip on it before releasing the door latch.

(2) Lift door latch (figure 1) and pull with an out and upward motion to free door from instrument.

Figure 1. Releasing door latch for door removal.

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2. CALIBRATION

The instrument is adjusted, calibrated, and inspected before it leaves the factory, and is ready for use when received. Instrument calibration, however, should be checked periodically and adjusted when necessary as specified in the servicing procedures.

3. SHUTDOWN

a. **GENERAL** If the instrument will be inactive for a short time period, merely switch off chart power; the amplifier will remain energized. If the instrument will be out of service for a week or more, or if service procedures are to be performed, turn off the main power switch. For pen dragging instruments which will be shut down for a week or more, evacuate the ink supply and flush out the ink system with water to prevent ink drying in the system.

b. USING INSTRUMENT AS AN INDICATOR ONLY.

(1) Instruments with a-c servo motor. On single-record or multirecord instruments with an a-c servo motor, the line winding of the servo motor is energized through the main power and chart switches. As an option, the chart switch can be bypassed so that the servo motor is energized through the main power switch only. This permits using the instrument as an indicator simply by turning off the chart switch. If this wiring option was not specified, the change can be made in the field by switching off instrument power and moving the white wire of the servo motor from terminal Wcs to terminal Wps on the amplifier-motor terminal block.

NOTE: When using a multirecord instrument as an indicator, turn off the chart switch immediately after the number of the desired record appears in the window of the printing mechanism.

(2) Instruments with d-c servo motor. These instruments can be used as indicators simply by switching off power to the chart motor.

4. RELATED PROCEDURES

Additional procedures, if required by the features and options supplied with this instrument, are specified later in this manual.

CHART OPERATION

1. GENERAL

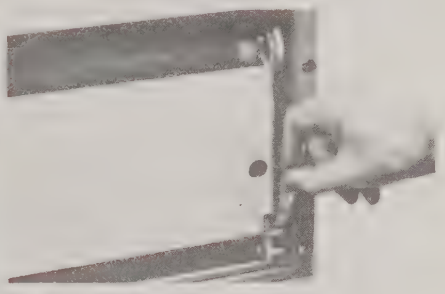
Standard strip charts are 122 feet long. The words RENEW CHART are printed at regular intervals on the last few feet of chart paper. The chart can be changed without withdrawing the chassis from the case or interrupting instrument balancing or controlling operations.

2. INSTALLATION

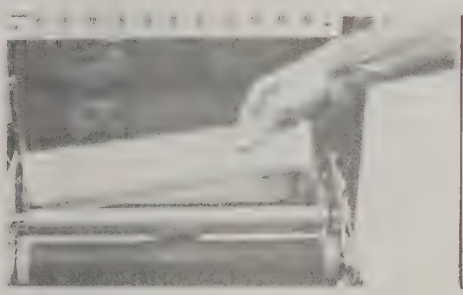
a. Install the chart for continuous, automatic reroll as follows. If the instrument has a chart saver device (optional) see paragraph 3, below.

1

Squeeze release latch and lower chart transport.

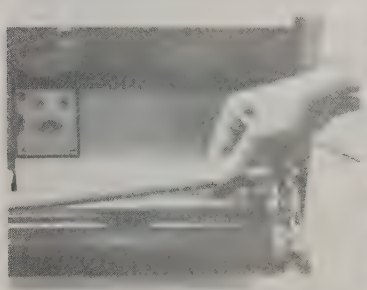


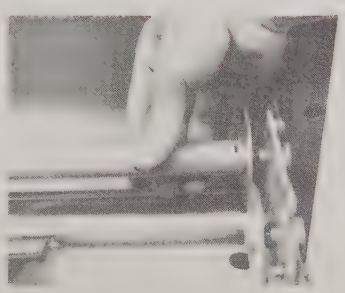
2 Grasp chart advance knob and swing transport through 90° arc.



3

Press used (rerolled) chart against spring loaded spindle, swing right end forward, and remove chart roll.

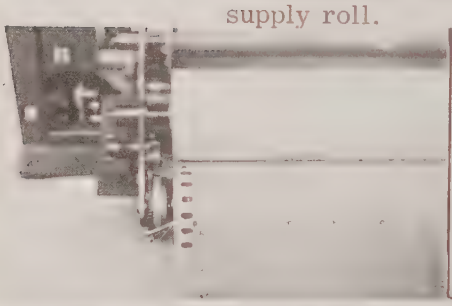




4 Remove empty supply roll from supply spindles and place on reroll spindles. (Empty supply roll will serve as reroll tube for new chart.) Be sure right hand spindle locks into notch in reroll tube.

5 Remove tape from free end of new chart roll and attach tape to reroll tube.

6 Place new chart roll on supply spindles so that chart unwinds from bottom. Make sure right hand spindle locks into notch in supply roll.



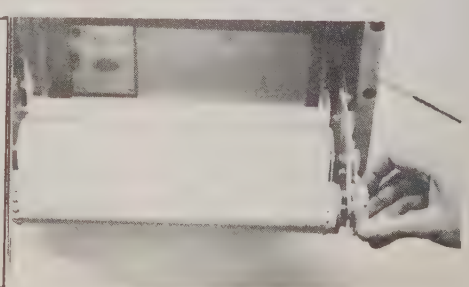
7

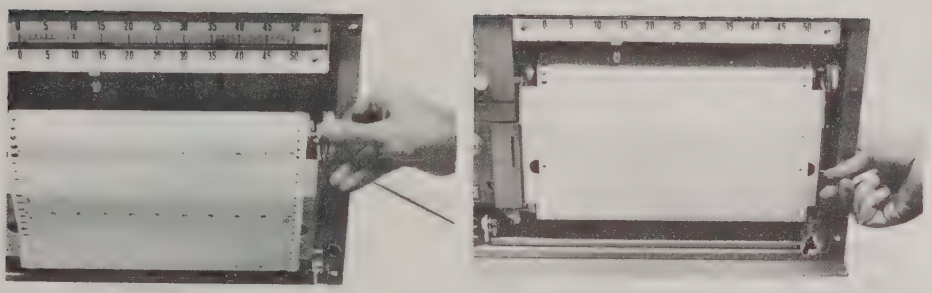
Unwind about 12 inches of chart paper and pass it over chart drum. Line up holes in chart paper with sprockets in chart drum.

8 Feed chart around front of transport (not around chassis pull bar) and attach free end of chart to tape on reroll tube.

9

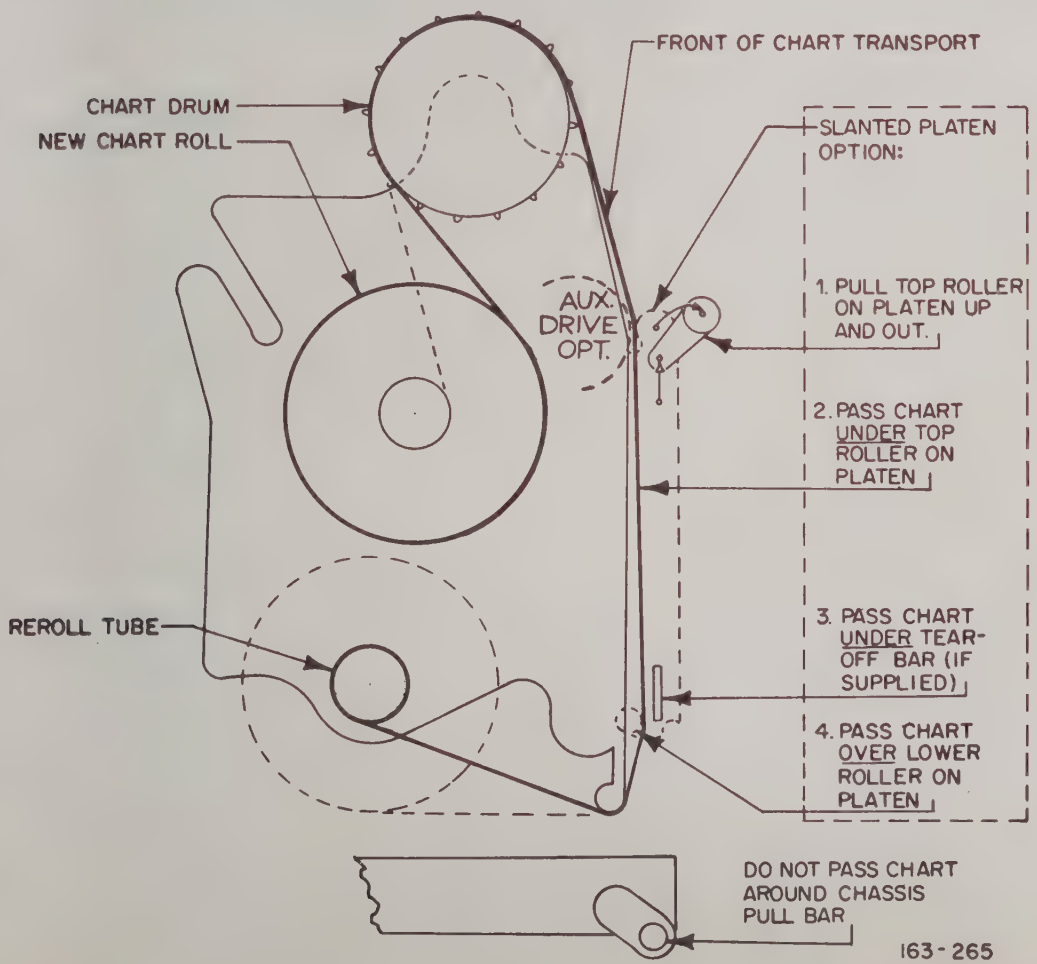
Turn chart advance knob to be sure that chart rerolls smoothly and evenly.





10 Raise chart transport, then lock release latch.

b. Time lines run horizontally on the chart. Before energizing the chart drive mechanism, turn the chart advance knob to align the correct time line with the pen.


FRONT OF CHART TRANSPORT
CHART DRUM
NEW CHART ROLL
SLANTED PLATEN OPTION:
1. PULL TOP ROLLER ON PLATEN UP AND OUT.
AUX. DRIVE OPT.
2. PASS CHART UNDER TOP ROLLER ON PLATEN
REROLL TUBE
3. PASS CHART UNDER TEAR-OFF BAR (IF SUPPLIED)
4. PASS CHART OVER LOWER ROLLER ON PLATEN
DO NOT PASS CHART AROUND CHASSIS PULL BAR
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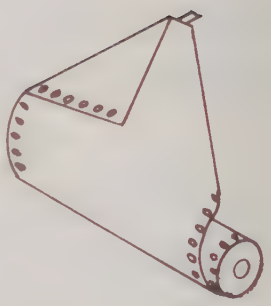
c. Some people prefer to cut or fold back the chart along the leading edge. This technique was originally intended for those instruments that require the chart to be fed through narrow slots. Some find that the chart also rerolls better this way. When using the chart saver this is a distinct advantage.



3. CHART INSTALLATION WITH CHART SAVER OPTION

a. The chart saver option consists of a wooden reroll bobbin connected to a spring clip through a retractable tape. When daily records are torn off the chart, the clip can be pulled up to the end of the chart, saving about 12 inches of chart paper.

b. Chart installation on instruments with the chart saver are the same as described above with the following exceptions.

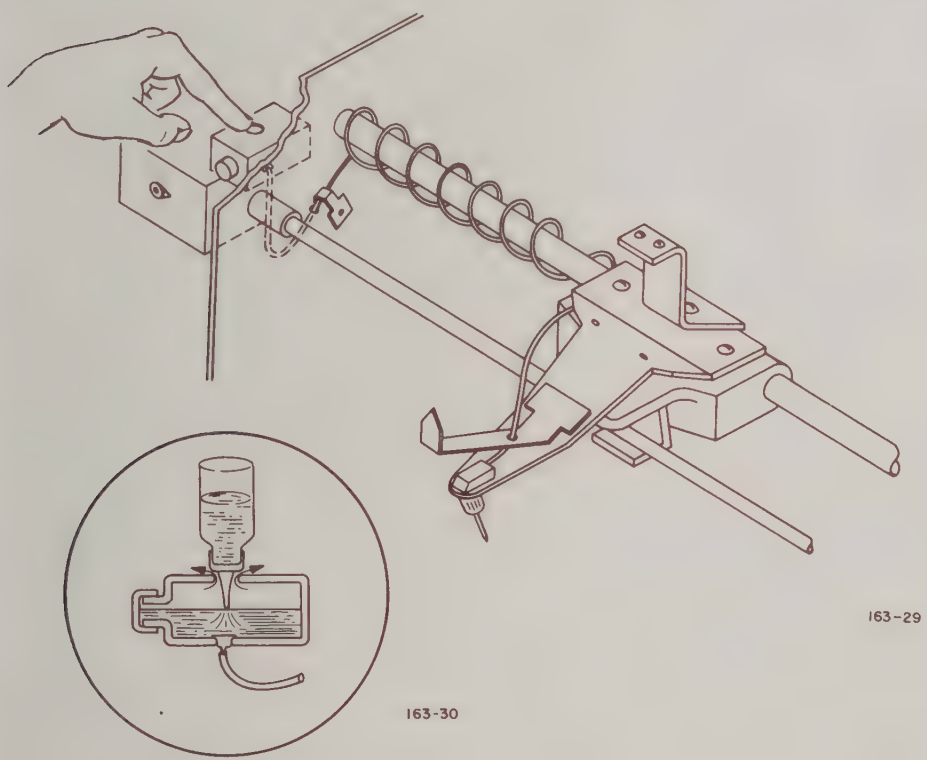
(1) Discard the empty supply roll tube.

(2) After winding the chart as shown in the preceding illustrations, attach the spring clip to the end of the chart. Release spring clip, allowing tape to recoil and place chart under tension.

RECORDING PEN **OPERATION**

1. GENERAL

The ElectroniK 16 Strip Chart Recorder uses the capillary type remote reservoir recording pen system, shown in figure 1. The indicator carriage and sapphire-tipped pen assembly are positioned by the servo drive cable. A separate plastic ink reservoir, remotely located in the ink compartment, supplies ink to the pen through a coiled ink delivery tube. This design features clear and reliable recording in conjunction with a generous 1-ounce ink supply and permits refilling the reservoir while the instrument remains in operation.



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163-30

2. FILLING AND STARTING

a. The drawer type ink compartment is located on the front panel of the instrument chassis. Use the knob provided to pull out the tray and gain access to the reservoir.

CAUTION: Do not use any ink other than the type supplied with the instrument. Other types of ink may clog the system and make unsatisfactory records. When a new ink supply is required, refer to the parts list for ordering data.

b. Using the squeeze bottle of ink supplied in the accessory kit, fill the ink reservoir to within 1/4 inch (approximately) of the top. Do not overfill.

NOTE: Don't block the filler hole in the reservoir with the neck of the supply bottle, allow space for air to escape (figure 1).

c. Either raise the pen off the chart (if the manual pen lifting device is provided) or lower the chart housing away from the pen assembly. Place a paper towel or blotter under the pen tip.

d. Place a finger over the filler hole in the ink reservoir and press down to force ink through the capillary system. Slide your finger off the filler hole and release pressure on reservoir. Several pumping actions may be required to completely fill the coiled ink delivery tube and the pen assembly. Force ink through the pen tip until it flows in a steady stream.

e. Replace the pen on the chart; it should start writing at once. If it doesn't, place a finger over the filler hole in the reservoir and press gently.

3. CLEANING

a. Clean the pen tip every month as follows:

(1) Lower the chart carriage away from the pen assembly, and place a paper towel under the pen tip.

(2) Place a finger over the filler hole in the ink reservoir and gently squeeze the reservoir to force a steady stream of ink through the pen tip.

(3) Swing the chart carriage back into the normal recording position.

b. The routine cleaning described above should remove any paper fibers or bits of dust collected by the pen tip. If this material is permitted to accumulate it can prevent normal ink flow and cause skipping.

c. If the pen is clogged or sealed by dried ink, use a fine wire (.005 dia.) to clear the opening. Lower the chart housing and push the cleaning wire through from the front of the pen tip.

NOTE: Never touch pen tip with fingers; oil film could clog tip.

d. Should the system contain dried ink, you may have to flush the entire system as follows:

(1) Apply pressure to the ink reservoir to remove air, then place a finger over the filler hole and release the pressure; this causes the ink to be extracted from the system. Repeat until all the ink has been returned to the reservoir.

(2) Empty reservoir and refill it with a detergent solution. Replace it and apply pressure to the reservoir to flush the solution through the system.

NOTE: A solution ratio of one teaspoonful of a low level controlled suds detergent in a gallon of water is recommended. Never use chemicals for cleaning, they may attack the pen system.

(3) Be sure to remove all traces of the detergent solution and flush the system with water. Remove as much of the water as practical before refilling the reservoir with ink. A small amount of detergent in the ink will reduce the surface tension of the ink and cause feathering of the record.

INSTRUMENT MAINTENANCE

1. GENERAL

a. Adherence to a routine inspection and maintenance program will insure optimum instrument performance and should reduce servicing requirements to a minimum. The checks and maintenance procedures included in this section are recommended to supplement normal industrial cleaning procedures.

NOTE: The frequency of periodic maintenance is a function of instrument operating time and balancing speed. For example, an instrument with a 0.2 second balancing speed may require more frequent maintenance than one with a 5 second balancing speed for the same number of operating hours. For continued satisfactory performance, establish a regular maintenance schedule in accordance with the instrument operating cycle. Include in the maintenance schedule the inspection of items such as relays, Micro Switch units, slidewire contacts, two speed gear box clutches and other parts subject to wear.

b. You can perform some maintenance with the instrument in service; but for certain procedures such as performance checks, you will have to shut down the instrument.

2. RECORDING SYSTEM

a. **RECORDING DEVICE.** Pen, printwheel, etc. are described elsewhere in this instruction (see table of contents).

b. **CHART.** Replace the chart when the warning RENEW CHART appears on the chart in service. Many people calculate how long a chart will last at the specific chart speed used, and replace charts periodically.

c. **SCALE.** Clean the scale (in place) as often as required to remove dirt, grease and ink. Use a soft cloth and a soap and water solution. Never use alcohol base solvents which may attack the lacquer finish of the scale.

3. DRIVE SYSTEMS

a. **CHART DRIVE.** Clean the gears of the chart drive system whenever required; use a stiff bristle brush.

b. **INDICATOR CARRIAGE DRIVE.** Instrument slidewires having exposed convolutions and contactors require periodic maintenance. Examine the slidewire and contactor assembly every month. When required, replace the contactors and wipe the slidewire convolutions with a dry lintless cloth or paper towel. Wipe the drive cable off with a clean dry cloth to remove any oil or dirt. Clean the servo drive gear with a stiff bristle brush when required.

NOTE: If the slidewire contactors are replaced, check instrument calibration (Service Section).

c. SELECTOR SWITCH (MULTIPOINT INSTRUMENTS). The input selector switch, which is geared to the chart drive system, requires periodic cleaning. With power off, disconnect electrical plug(s) between chassis and case, disconnect telescoping shaft, and remove chassis from case. Remove selector switch cover and, if necessary, clean switch wiper and segments with solvent (carbon tetrachloride or similar). Replace cover and restore normal connections.

4. CONTROL SYSTEMS (PROPORTIONING RESISTORS)

Instruments supplied for proportional control have a proportioning resistor(s) which requires the following maintenance.

a. TYPE I RESISTOR. The "pancake" type resistor, mounted in a dust resistant enclosure, may be easily inspected by removing the enclosure cover. If necessary the contactors, contact ring and contact surface of the resistor may be wiped clean with a lint free cloth.

CAUTION

(1) Shut off power to the instrument before opening resistor enclosure.
(2) Do not bend contactor arms.
(3) Do not use abrasives, solvents, or oil of any kind on resistor winding.
(4) Replace resistor enclosure cover carefully; do not snag or entangle drive cable.

b. TYPE II RESISTOR. The "cartridge" type resistor is not enclosed and may require more frequent examination and cleaning. As often as necessary, clean the contactor and bare portion of the resistor with a lint free cloth. Observe the same precautions as stated for Type I.

LUBRICATION **MAINTENANCE**

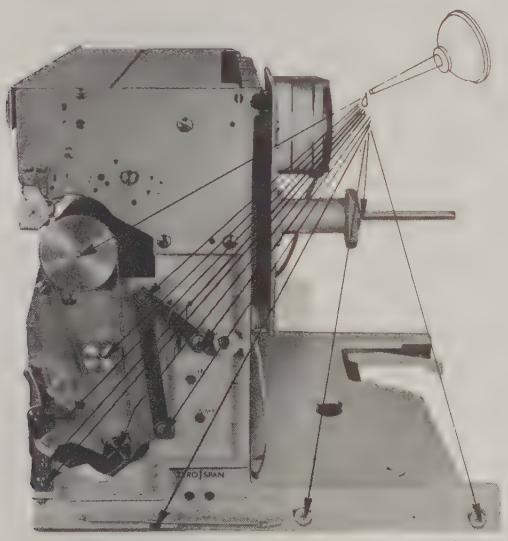
1. GENERAL

a. A 2-ounce bottle of type L-1* oil is supplied with the instrument for lubrication. You can get this oil in 1-ounce bottles from Honeywell, Philadelphia Division; Specify part number 79329.

b. Wipe any dirt accumulation from the areas to be oiled before oiling.

c. The motors are factory lubricated and do not require periodic lubrication.

d. Once a month, oil lightly at all the points indicated on the following lubrication diagrams.



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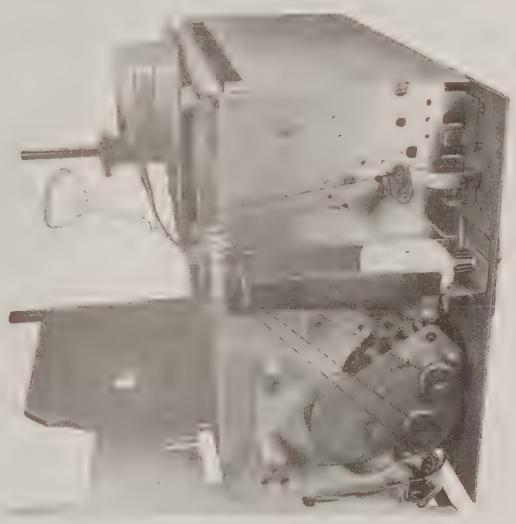
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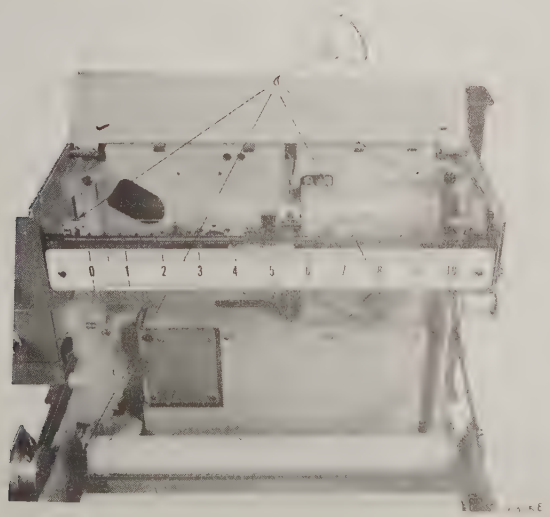


** Honeywell Material Spec. B-553.*

e. Some typical lubrication points are identified in the illustrations; be sure to lubricate:

(1) All gear bearings on the chart drive mechanism.
(2) All chart drive gear bearings on the chart carriage.
(3) All pivot points and bearings on the chart carriage, including the chassis handle pivots.
(4) Ink compartment guide bearings.
(5) Instrument chassis guide bearings.
(6) Servo drive shaft bearing.
(7) Bearings on the guide pulleys for the drive cable.
(8) Apply light grease to channel tracks in chassis, if necessary.

NOTE: Never lubricate the drive cable(s) or pen carriage guide bars.

INSTRUMENT **THEORY**

1. GENERAL

a. This instrument uses a potentiometric rebalancing system as illustrated by the servo loop shown in Figure 1. The basic servo loop includes the primary element, measuring circuit, amplifier, servo motor, and indicator.

b. The primary element continuously detects the value of the measured variable and sends an input signal to the instrument; the input signal (Ein) will be proportional to the magnitude of the measured variable.

c. The measuring circuit determines the millivoltage drop across the slidewire while the position of the slidewire contactor assembly determines the magnitude of the feedback signal (E fb).

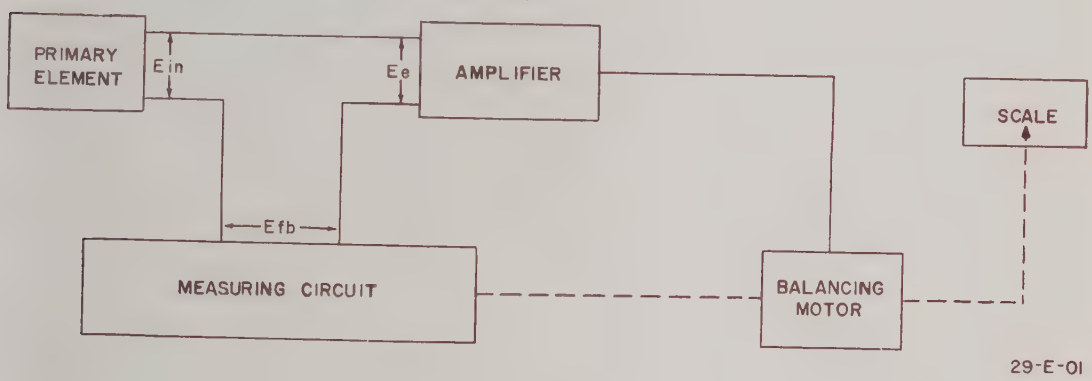


Figure 1. Simplified Servo Loop.

2. BALANCE

a. The feedback signal (E fb) and the input signal (E in) are compared by the amplifier circuit (by cancellation) and the difference, or error signal Ee, is then amplified. The error signal is usually on the order of a few microvolts (dc); first it's converted to a proportional a-c signal and then amplified to drive the servo motor. The servo motor responds to the error signal by rebalancing the measuring system which simultaneously repositions the indicator assembly and changes the magnitude of the feedback voltage until the error signal is reduced to zero. At balance Ein and Efb are equal and Ee is zero. If Ein is greater than Efb, the polarity of Ee will be (+) and the indicator will be driven upscale; if Ee is negative (Efb greater than Ein) the indicator will be driven downscale.

3. DAMPING

Any self-balancing system is inherently oscillatory because the inertia of the moving parts prevents the system from stopping exactly when the balance point is reached. To obtain a satisfactory balance action it is necessary to introduce a feedback loop which, in effect, anticipates the final balance point and causes the system to decelerate before the balance point is reached. The system inertia then causes a rapid drift into the balance position.

MEASURING CIRCUIT — THEORY

1. MILLIVOLT ACTUATION (basic circuit)

a. GENERAL

(1) The millivolt actuation can be considered as the basic potentiometer type measuring circuit. It receives an error voltage from any sensing element having a millivolt output. The measuring circuit schematic is shown in figure 1. All other circuits are modifications of this basic circuit.

(2) The output of the constant voltage circuit is applied across the parallel resistances of the measuring circuit branches and causes a 6-milliampere total current to pass through the equivalent resistance of the measuring circuit (343.33 ohms). This current divides in accordance with the resistance ratios of the various circuit branches. Current limiting resistors in each branch maintain 4* milliamperes through the upper branch and 2* milliamperes through the lower branch. (The terms upper and lower branches merely refer to the locations shown in the schematic diagrams).

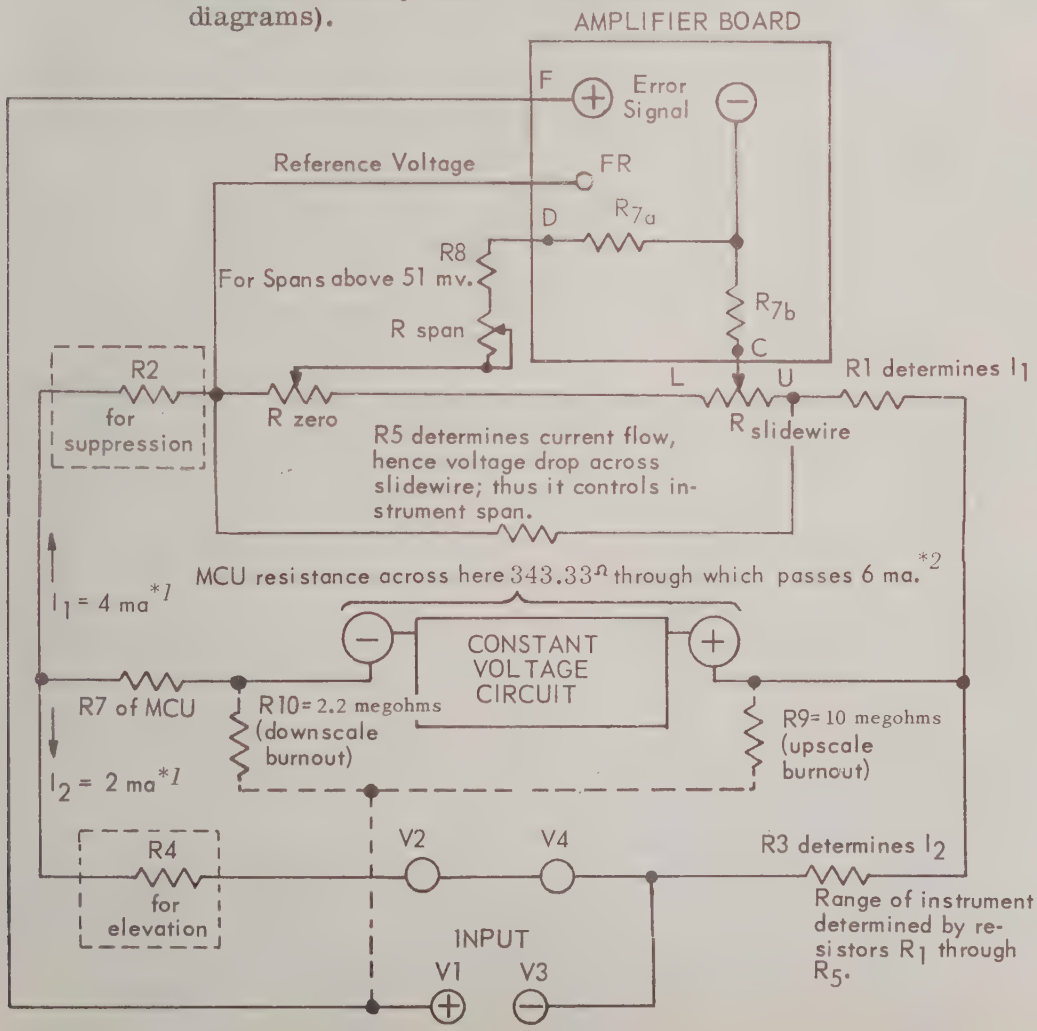


Figure 1. Schematic Millivolt Actvation

*1 *On spans greater than 51 millivolts, currents I_1 and I_2 are 5.5 and 0.5 milliampere respectively on thermocouple actuations, see table in section 533.*

*2 *Except for Resistance Bulb Thermometer Actuations*

b. SPAN. The region between the limits of measurement (from input of 0% to input of 100%).

(1) The span of the instrument is determined by the current flowing through the slidewire. This current, and therefore the span, is determined by resistor R5 and the fine span adjust rheostat R span.

(2) R span provides a voltage divider action (in conjunction with the span network) permitting critical adjustment of the balance position feedback voltage, and in effect changes the span.

c. ZERO.

(1) The path of I, is divided into three sections to permit determination of reference voltages corresponding to 0% and 100% of scale, i.e., both limits of slidewire travel.

(2) The zero adjustor R zero produces a linear shift of the zero position and all other points on the instrument scale without significantly affecting the instrument span. This adjustor is effectively an extension of the suppression resistor and permits critical determination of the zero position. Decreasing the portion of the Rze used in the circuit causes all points to shift upscale; a downscale shift results when the effective resistance is increased.

d. SUPPRESSION. The instrument reading when position of slidewire contactor is at lower limit.

(1) Suppression (giving 0% full scale position a positive value above zero) is obtained by a voltage drop across the R2 spool and the zero adjust rheostat Rze.

(2) Elevation of the 0% position is determined by the voltage drop across the R4 spool.

(3) Due to the position of the zero adjustment in the circuit, the circuit has suppression of approximately 30% of span when R2 and R4 are both zero. Therefore, any range which has a suppression less than 30% of span uses resistance in the R4 position.

e. BURNOUT OPTION. Provides the warning feature of driving indicator to end of scale if input circuit should open.

(1) The burnout resistor develops a voltage drop between the measuring circuit and the amplifier. The polarity of this signal determines the direction of servo drive upon an open circuit in the input. R9 applies a positive voltage to amplifier terminal F in order to drive the system upscale; R10 provides a negative voltage for downscale drive.

(2) Resistor R7 of the Measuring Circuit Unit (MCU) has a value of 10 ohms and is located between the negative output terminal of the constant voltage circuit and the measuring circuit. Its purpose is to develop a small voltage differential between the circuit reference potential Fr and the negative constant voltage circuit terminal.

2. THERMOCOUPLE ACTUATION

a. This actuation receives an input signal generated by a thermocouple primary element. The basic potentiometer measuring circuit is modified (figure 2) to accommodate thermocouple primary elements by the addition of the reference junction temperature compensation spool on the input terminal panel. Rrj compensates for variations in the ambient temperature at the reference junction.

b. For thermocouple actuations, the value of R3 is determined by the required current through the compensation resistor, as required by the particular type of thermocouple. Therefore R1 serves only to keep the amount of current drawn from the constant voltage circuit at a constant value. The function of the R2 resistor is the same as on the millivolt actuation.

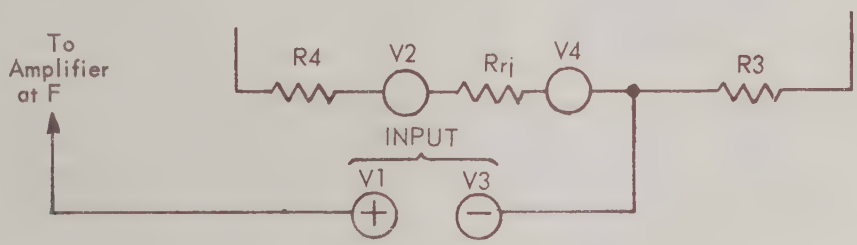


Figure 2. Partial schematic, thermocouple actuation, a variation of the millivolt measuring circuit.

3. RADIAMATIC* PYROMETER

On measuring circuits designed for use with the Radiamatic unit the span adjustor circuit is used to compensate for non-blackbody applications. This approach assumes a ±10% nominal span adjustment. The circuit is the same as for the millivolt actuation (figure 1).

4. TACHOMETER ACTUATION

a. The circuit used for tachometer actuations (figure 3) is essentially a millivolt circuit with a suitable voltage divider preceding it. A 1-megohm series resistor R12 is used for spans from 1 volt to 300 volts. A 0.1-megohm resistor (series) is used for spans less than 1 volt which cannot be handled by the standard millivolt circuit.

b. The relatively high voltage output of the tachometer generator is applied across a series-shunt-voltage divider; a proportional voltage is developed across the measuring circuit shunt resistor R11. The circuit is precalibrated to a standard millivolt range (10 mv). A full scale output voltage from the generator will develop the full 10-millivolt signal across the shunt resistor while any smaller output will produce a proportionally lower voltage.

**Honeywell Trademark.*

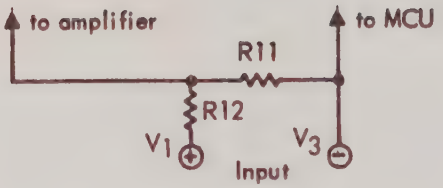


Figure 3. Partial Schematic, tachometer, d-c volts, a variation of the millivolt measuring circuit.

5. D.C. VOLTAGE ACTUATION

This actuation is accomplished by the same basic circuit (figure 3) used for the tachometer actuations. It includes suitable series and shunt resistors that reduce the high magnitude input voltage to the range of the measuring circuit

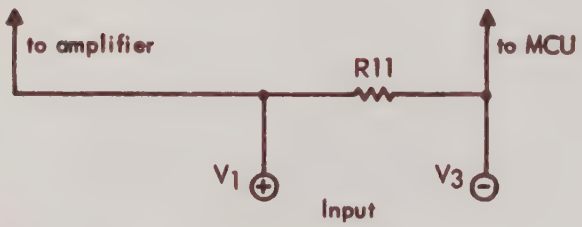
6. D.C. CURRENT ACTUATION

The circuit for the d-c current actuation (figure 4) consists of a shunt spool (R11, across which the input current develops a voltage) in conjunction with a standard millivolt circuit. The value of R11 depends on the requirements of the signal source, but it must be between 0.25 ohm and 10,000 ohms, and must develop a millivolt span between 5 millivolts and 51 millivolts. Therefore, the input current span has the following bounds:

Ma span larger than 0.0005 ma
Ma span smaller than 204.0 ma

The suppression cannot be larger than three (3) times span.

$$|\text{Ma supp.}| < 3 \times \text{Ma span}$$



7. RESISTANCE THERMOMETER

a. The electrical span and suppression of the three-wire resistance thermometer circuit (figure 4) are selected to suit the sensing element and the application. Range resistors are sized to maintain the appropriate currents through each branch of the circuit. Resistors R1, R2, and the span network serve the same functions as on millivolt actuations.

b. The current through the resistance element (Rx) is maintained at a constant value due to the relative magnitudes of R3 and Rx. A resistance change in Rx has no apparent effect on the current (Ic), but the voltage drop across Rx changes. This drop is nulled by the drop across the span and suppression network. Any difference between these potentials becomes the error signal to the amplifier, and rebalancing action is initiated. Thus a true null balance type resistance measurement is accomplished and the measuring circuit has an output linear to the input.

c. Leads A and B must have equal resistance, but the actual resistance magnitude is unimportant. Resistors R3 and R6 are sized to maintain the appropriate currents through leads A and B; so the equal and opposite voltage drops across these leads cancel.

d. Currents Ib and Ic combine and must pass through lead C of Rx since an equipotential (10-volt reference) is maintained between the circuit branches. The approximate resistance of lead C was considered in the calculation of R4, and variations are insignificant compared to the magnitude of R4.

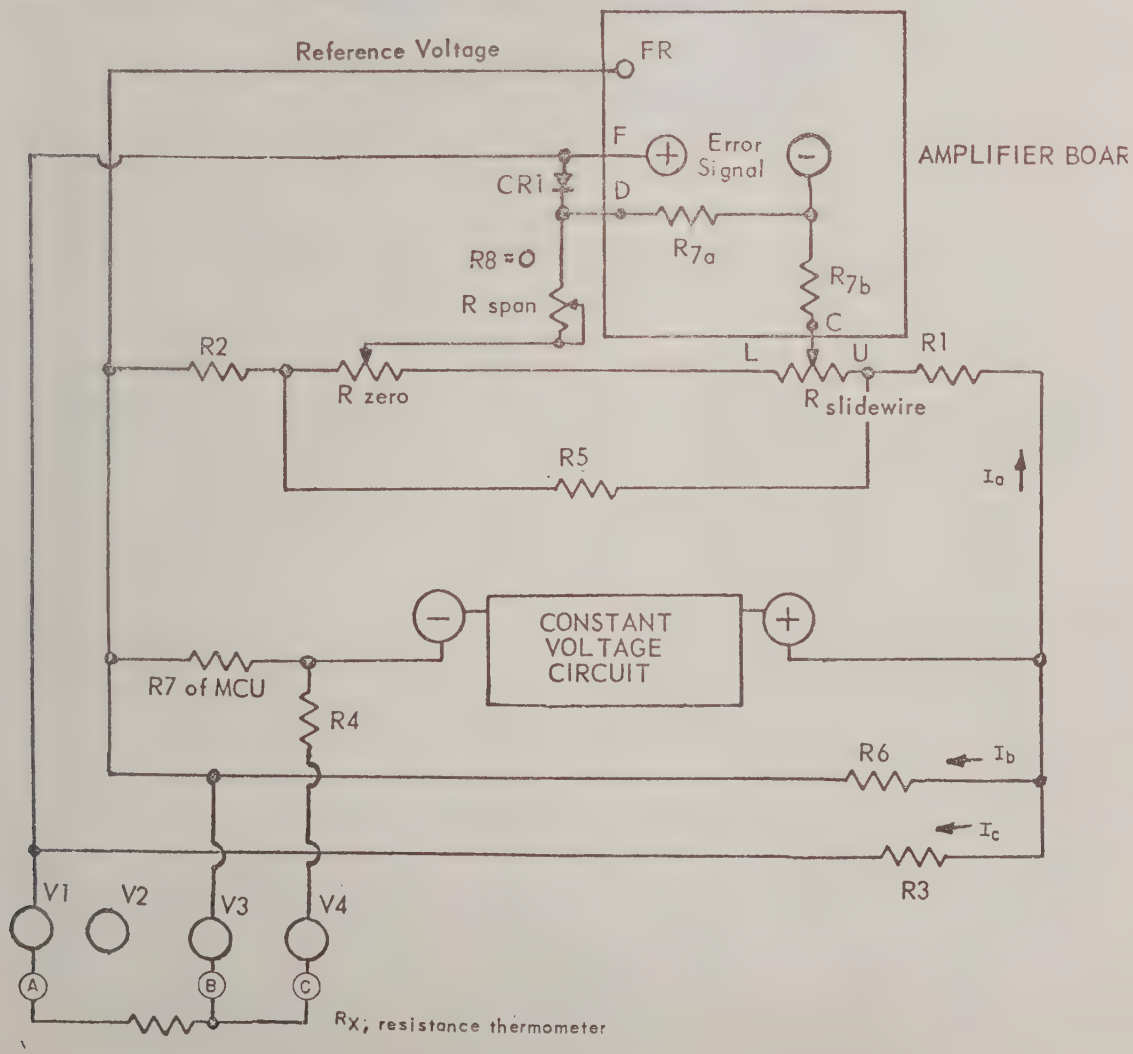


Figure 5. Schematic, resistance thermometer actuation.

FILTER BOARD for SLIDEWIRE

THEORY

1. PURPOSE & USE

Input signal (input from sensing device) passes through filter immediately before entering amplifier. The purpose is to attenuate unwanted signals and to provide filter damping.

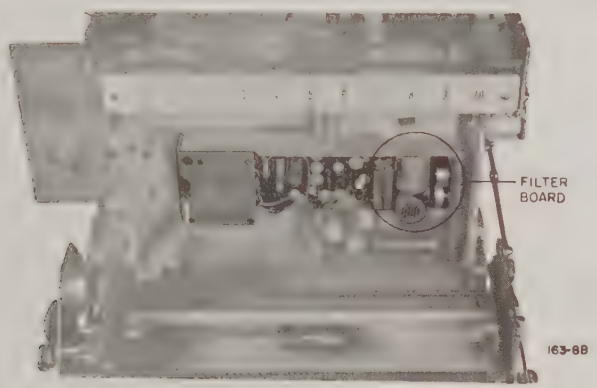


Figure 1. Location of Filter Board in a typical instrument.

2. CONCEPT

a. This input filter is a two stage ladder network. One stage is an R-C filter and the other is a tuned (at 60 cps) series arm followed by a capacitor. This provides maximum rejection of 60 cps input series signal.

b. The damping signal is provided by a lead-lag network in feedback path. The damping adjustment moves lead-lag dipole back and forth in the frequency domain without changing d-c gain of the network. A greater input resistance variation can be tolerated with this damping scheme, without affecting damping characteristics.

CAUTION:

To measure filter board components do not use d-c such as found on resistance measuring "range" of many multimeters. The tuned choke and input transformer can become magnetized, and make the whole assembly sensitive to mechanical shock (microphonic) and possibly, introduce stray problems.

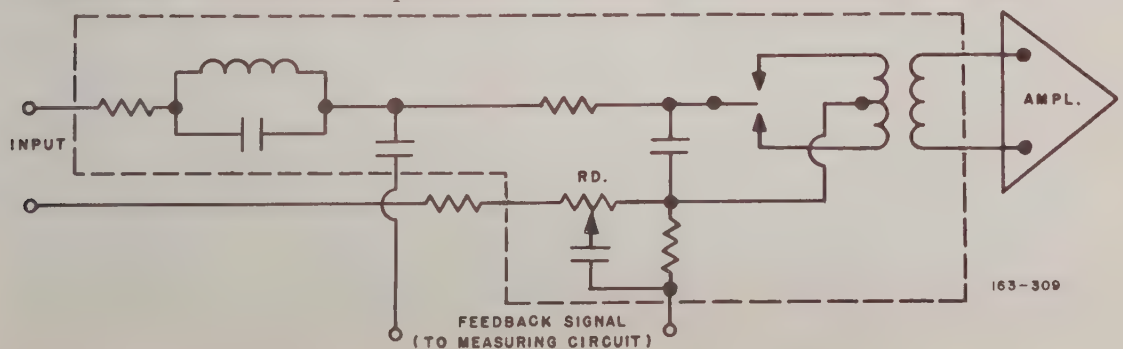


Figure 2. Schematic of Filter Board.

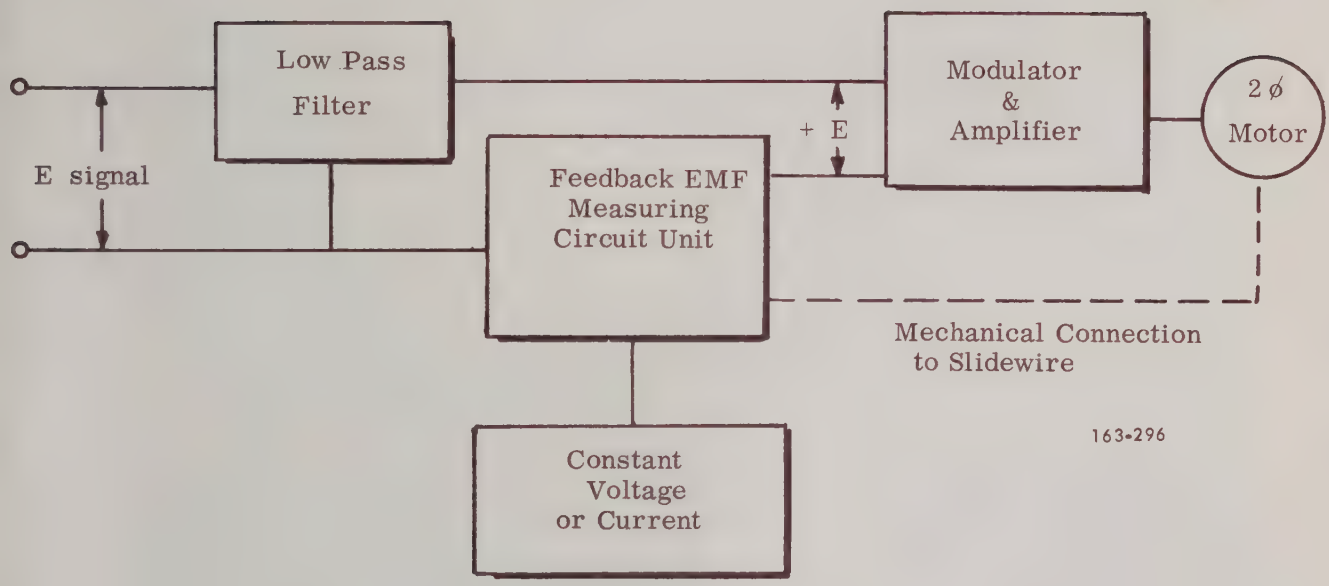


Figure 1. "Block Schematic" of Instrument

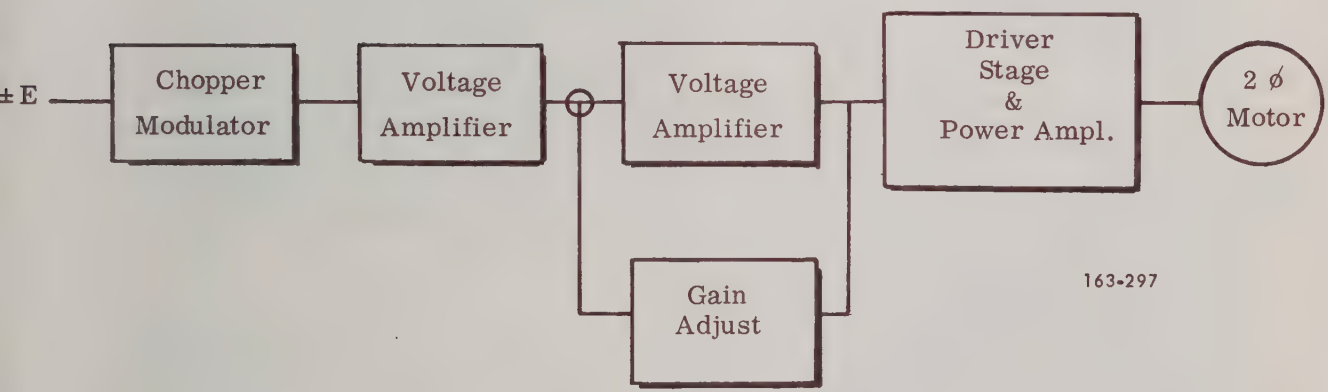


Figure 2. Block Diagram of Amplifier

1. VOLTAGE AMPLIFIER

a. The voltage amplifier board contains a total of seven NPN silicon transistor stages. The first is a low noise, high impedance field effect transistor (FET) stage operated with zero gain bias. The second is an impedance transforming emitter-follower stage directly coupled to the third, a common emitter voltage gain stage. The d-c bias levels on stages two and three are set and maintained by resistive feedback from the collector of the third stage to the base of the second.

b. Stages four, five, and six are direct coupled as a high gain block, the biases of which are all set by a d-c feedback around the block. The 60 cycle a-c gain of this block is varied by changing the a-c feedback with the gain adjustment.

c. Stage three is coupled to four by capacitor C_4 and R_8 in series when used for low gain operation, since some of the signal is lost across R_8. Stage 3 is coupled to C_4 alone when the gain jumper is set for high gain operation, shunting out R_8.

d. Stage seven is an impedance transforming stage directly coupled to stage six, and serves as the power amplifier driver.

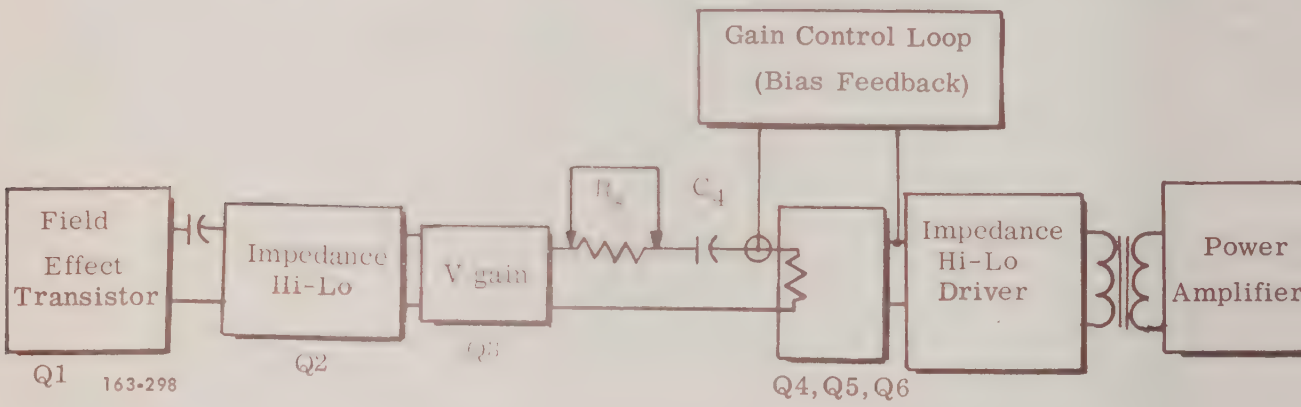


Figure 3. "Block Schematic" of Voltage Amplifier Board.

CAUTION: The servo motor used with this amplifier is designed to match the low output impedance of the power transistor for maximum efficiency. It has a nominal control winding voltage rating of 12 volts. Do not use this amplifier with any other type of motor or the amplifier will be damaged.

2. AMPLIFIER REFERENCE (SHIELD)

The amplifier reference is a continuous common connection throughout all circuits except the driver stage and the servo motor circuit which are isolated from the reference. The converter case and the cores of transformers T2 and T3, and the shields of transformers T1, T2, and T3 are connected to the reference. The reference is connected to the measuring circuit shield and assumes the potential of any stray signal encountered by the amplifier; thus, the reference floats at stray signal potential with respect to ground.

3. POWER AMPLIFIER

The power amplifier is a cascaded emitter follower (Darlington) connected, silicon NPN transistor stage transformer coupled to the driver stage at the voltage amplifier. This stage* and the motor constitute a phase demodulator capable of producing proper direction of motor rotation for a given d-c error signal applied to the amplifier. The stage is biased to provide proper dither, and employ resistive feedback to lower the output impedance.

*There are two stages on the Push-Pull amplifier.

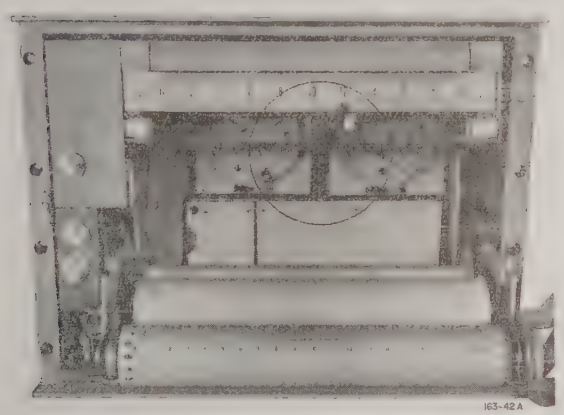
1. GENERAL

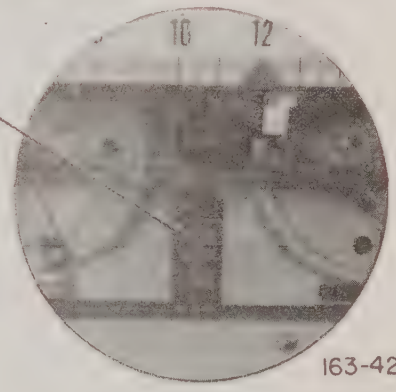
This section includes procedures for the isolation of malfunctions by performance symptoms; for the isolation of defective components by voltage and resistance checks; and for the disassembly, reassembly, and adjustment of the instrument to correct for a malfunction. Wiring diagrams and check point location diagrams are included where applicable.

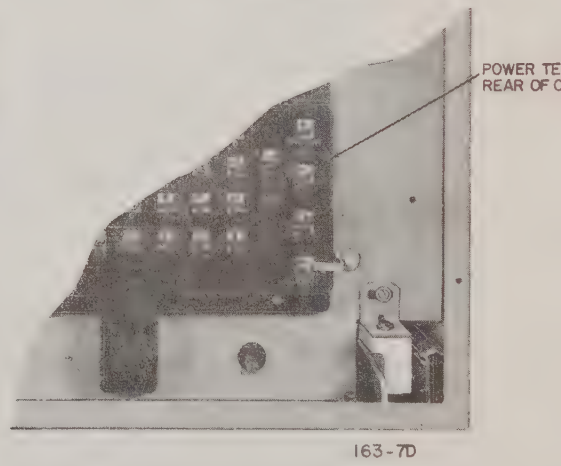
2. TROUBLESHOOTING PROCEDURE

The servicing procedures are intended to permit maximum analysis with minimum test equipment and minimum downtime. The following approach is used:

a. Identify the malfunction in terms of instrument performance and locate the trouble under Symptomatic Analysis.







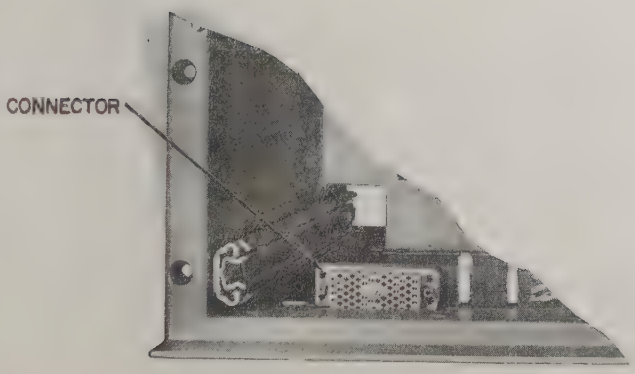


Figure 1. Test Point Locations

b. Follow the procedures to isolate the faulty component.

c. Replace a faulty component whenever possible.

d. Separate sections include troubleshooting procedures for repairing and placing some defective parts back in operation.

3. SYMPTOMATIC ANALYSIS

a. NO DRIVE

(1) Make sure the instrument and its various assemblies are being supplied with power. With instrument power switched on, check (with a multimeter) for 120 V ac at the following locations (figure 1):

(a) Between the NEUT. and HOT terminals on the input terminal panel.

(b) Between the terminals A and B on female half of the 64-point chassis connector.

(c) Between the white and black leads of the servo amplifier's 5-wire power cable (terminals W and B on the servo terminal block).

(2) Check that the cable drive system is free to move. Turn off instrument power and rotate the drive gear to position the indicator at 50% full scale. Turn the instrument power on. If the indicator does not move, the condition of 'No Drive' has been verified. If the indicator moves to either end of scale, refer to the symptom 'Drives Against A Stop'.

(3) Remove the primary element input connections and use a multimeter to check for continuity across the input terminals; observe proper polarity. The resistance should be a measurable quantity (100,000 ohms is considered an open circuit). During this test, the multimeter is applying a voltage to the instrument; if this causes the balancing motor to drive the trouble is external to the instrument. Check the primary element and its associated wiring.

(4) If the motor does not drive in step (3), connect the multimeter directly to the amplifier. Remove the 5-pin connector from the measuring circuit panel, jumper pins D and FR and connect the multimeter between pins D & F. If this causes the motor to drive, the trouble is probably in the measuring circuit or the rebalancing device; check these components.

(5) If the servo motor fails to drive in step (4), use a second multimeter to check the voltages across the balancing motor's windings. These voltages, measured at the servo terminal block (see Amplifier schematic), may be analyzed as follows:

Test Voltages		Probable Cause
Line Winding (Yellow and White Servo Motor Leads)	Control Winding (Red and Green Servo Motor Leads)	
120 Vac	0 to 7 Vac (amplifier output)	Open Line Winding or shorted capacitor (C-13)
240 Vac	20 Vdc; 0 Vac	Open control winding
240 Vac	0	Shorted control winding (balance motor should be hot) or shorted capacitor (C-14)
0	0 to 7 Vac (amplifier output)	Shorted line winding (balance motor very hot)

NOTE: If you don't have a second multimeter, use a dry cell to supply the drive signal.

(6) Replace the suspected component if a spare is available.

b. DRIVES AGAINST A STOP

(1) If the instrument has the optional burnout feature check for an open input circuit.

(2) Disconnect the primary element and connect a multimeter across the instrument input terminals (see schematic). If the instrument does not respond, reverse the connections.

(3) If the instrument responds in step (2), check the primary element and its associated circuitry.

(4) If the instrument does not respond in step (2):

(a) Check the slidewire and contactor for dirt, misalignment, or excessive wear.

(b) Check continuity of slidewire at measuring circuit connections.

(c) Check output of constant voltage circuit.

(d) Check measuring circuit resistances.

(e) Check amplifier by substitution.

c. ERRATIC

(1) Shake the various internal input wires, while observing instrument performance to see if an intermittent open circuit can be located. Also check the primary element and associated external wiring for an open circuit. Check for transient stray signals which may exceed the instrument specifications.

(2) Check all connections to the amplifier and power assembly circuits, the measuring circuit, constant voltage circuit, chassis terminal block, chassis connector, and slidewire assembly.

(3) Check the slidewire contactor for excessive wear, poor tension, or misalignment. Check the slidewire for dirt or wear.

d. INSTRUMENT IS INSENSITIVE

(1) Check amplifier gain setting.

(2) Check shield connections and reference wiring (if applicable).

(3) Verify that stray level does not exceed instrument rating.

(4) Make sure gearing and cabling of balance system are free to move.

(5) Check amplifier by substitution if a spare is available.

e. CALIBRATION SHIFT

(1) Make sure the settings of the zero or span adjustors have not been changed.

(2) Check stray level.

(3) Check output of constant voltage circuit.

(4) Check measuring circuit by substitution if a spare, calibrated for the particular instrument, is available.

(5) Check that drive cable is securely attached to the indicator-carriage assembly.

CALIBRATION PREPARATION SERVICE

1. PREPARATION PROCEDURE

a. Remove steel cover from rear of instrument case so connection terminals are accessible.

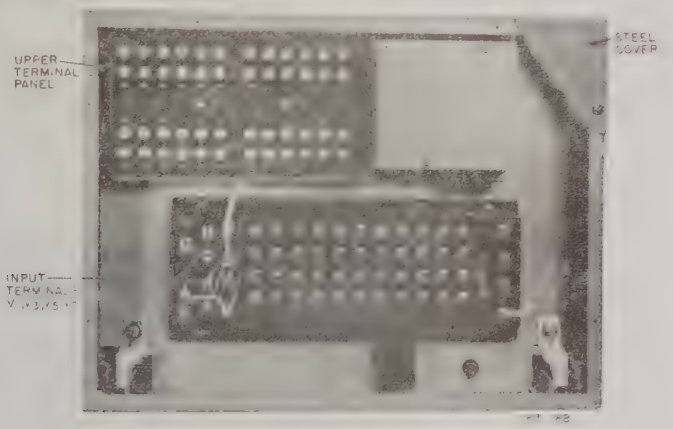


Figure 1. Rear of Typical Case (multipoint)

b. Remove input conductors from terminals V_1, V_3, V_5, and V_7. (On Multipoint with thermocouple actuation, remove an input from Upper Terminal Panel).

c. Connect a calibration cable to instrument input terminals.

CAUTION: Before touching any instrument connections, be sure no dangerous stray voltages exist.

d. Reinstall instrument cover plate. Take care not to pinch and short calibration cable against instrument case. It is essential to replace this cover for maximum calibration accuracy, especially on instruments with thermocouple actuation.

e. Where it is inconvenient to run calibration cable from rear of the instrument, the cable can be brought through instrument to the front as shown in Fig. 2.

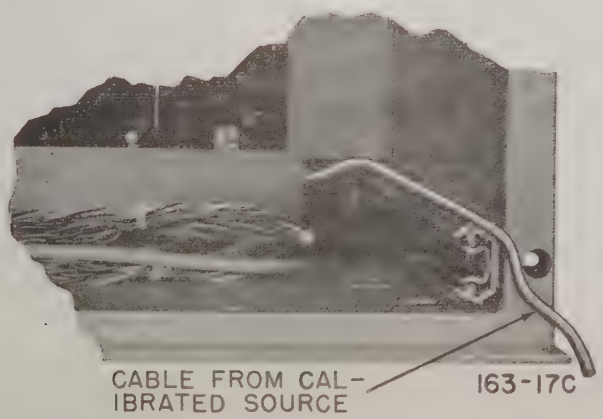


Figure 2. Calibration cable routing to the front

2. CALIBRATION CABLE

a. Usually a twisted pair of copper wires is all that is needed, except for thermometer and resistance thermometer actuations.

b. Narrow span millivolt actuations may require a shielded cable. Only cables having copper inner and shield conductors are acceptable.

c. Instruments with thermocouple actuations can be calibrated by two techniques, as described in Calibration Methods. When ice bath method is used, calibration cable is made from the thermocouple wire type for which actuation is designed (such as iron constantan, copper constantan, etc). Otherwise, use a twisted pair of copper wires.

d. Never use clips or lugs for connecting calibration cable. Connect only bared cable conductors.

3. CONNECTION POINTS

a. MILLIVOLT, RADIAMATIC, RESISTANCE THERMOMETER, D-C VOLTS, AND D-C CURRENT ACTUATIONS.

(1) Single pen and multipoint: Connect to points V_1 and V_3

(2) Two pen: Connect 2nd pen to points V_5 and V_7

(3) Shields: If the jumper buss originally supplied with the instrument has been removed, connect shield 1 to V_3 (shield 2 to V_7).

(4) On multipoint instruments calibration is made easier if print mechanism is stopped. If your instrument has no switch (option), this can be done by removing one of the gears in print motor gear train (retained by thumbscrew or split cotter).

b. THERMOCOUPLE ACTUATIONS

(1) One and two pen: connected same as with millivolt. Terminals, however, are on a small compensator block at the same location.

(2) Multipoint: connect to plus and minus terminals of that number on upper terminal panel which corresponds to the record number on print wheel. Regardless of actual character indicated (if other than a numeral), the character adjacent to large dot on indicator wheel is in position of terminal nine (9).

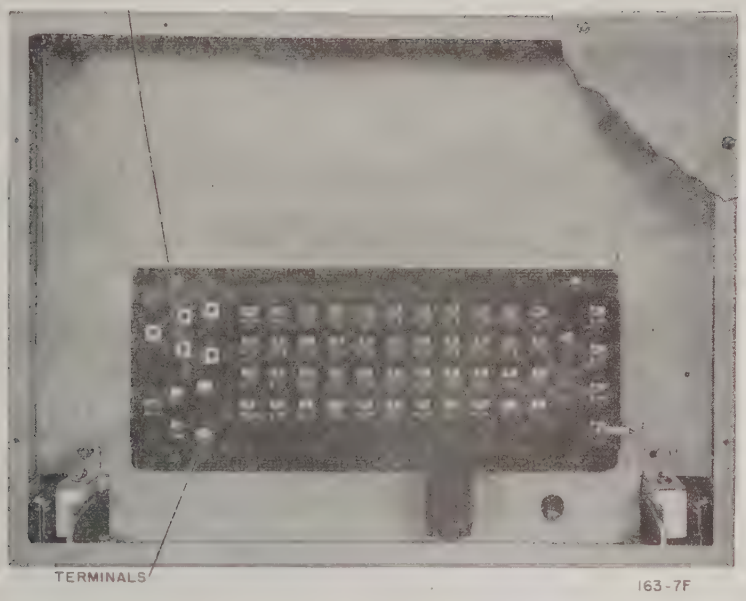


Figure 3. Rear of Typical Single Pen Case with Thermocouple Actuation

4. CALIBRATION METHODS

a. MILLIVOLT, RADIAMATIC, AND OTHER UNCOMPENSATED ACTUATIONS.

(1) Connect a precision voltage source (such as Honeywell Series 2700 or equivalent) to input terminals.

(2) Connect positive conductor to V_1 (V_5 on two pen), the negative to V_3 (V_7 on two pen).

b. RESISTANCE THERMOMETER ACTUATION

(1) Resistances of the wires usually affect the instrument reading. The instrument is best calibrated in its installation and by using a precision resistance decade box in place of the thermometer, at the thermometer location.

(2) Where instrument is not calibrated in its location, the calibration circuit should simulate resistances of wires and circuit of intended instrument installation. Typical circuits are given in the section on Measuring Circuit Theory (see table of contents).

c. D-C VOLTS OR D-C CURRENT ACTUATION.

(1) Use suitably calibrated d-c source to drive pen or indicator to required scalar positions. Follow a method similar to that outlined for millivolt actuations.

(2) If a voltage greater than 300 volts (dc) is applied to instrument, the 1.5 megohm current limiting resistor at terminal panel must be changed to limit current drawn from shield to a maximum value of 0.2 milliamperes. A shock hazard to personnel would otherwise exist.

4. **THERMOCOUPLE ACTUATION.** Two alternate methods of calibration may be used for instruments with thermocouple actuation. Highest accuracy will be obtained if a precision voltage source is used in conjunction with an ice-bath: however, reasonable accuracy can be obtained without the icebath. The input voltages used in the calibration procedure must be determined from a table of temperature-emf equivalents* (reference 0° C or 32° F) for the specific type of thermocouple employed.

(1) Reference Temperature - 0° C (32° F)

(a) Connect conductors from precision voltage source to a pair of compensated wires (thermocouple extension wire) for the particular thermocouple actuation, such as copper constantan, etc. Observe proper polarity.

(b) Connect the compensated wires to the instrument input terminals. Observe proper polarity (red thermocouple wire is negative).

(c) Immerse each junction of a copper lead and an extension wire in a melting ice bath; keep the junctions electrically insulated from each other and from the bath. Allow the junctions to stabilize at 0° C (32° F). Stir bath to obtain highest accuracy.

(d) Determine input voltages directly from a table of temperature -emf equivalents (reference 0°C or 32°F) for the specific type of thermocouple.

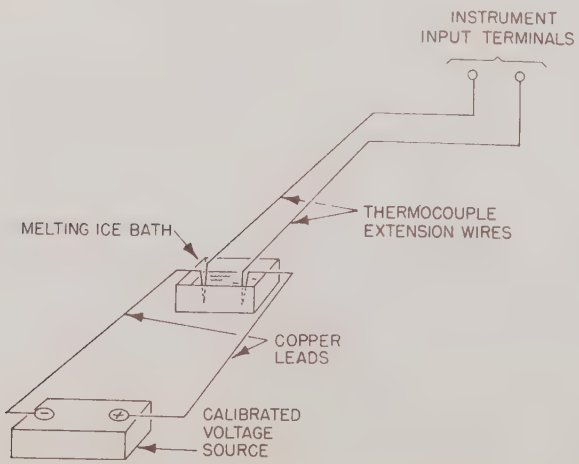


Figure 4. Test Connections for Ice Bath

(2) Reference Temperature - Ambient

(a) Connect conductors of precision voltage source directly to instrument input terminals. Observe proper polarity.

(b) Use a mercury thermometer to determine temperature at reference junction in instrument. (Access hole is provided in terminal cover.)

NOTE: Never close instrument chassis while thermometer is inserted in reference junction access hole.

(c) Determine input voltages by algebraic addition of emf equivalents for reference junction termperature with those for required scale readings.

Figure 5. Typical Case Interior

(3) If a Honeywell Model 2720 is used as voltage source, temperature e.m.f. equivalent of the reference junction temperature should be determined. The Model 2720 should then be compensated for this value. All subsequent values may be read directly without necessity of subtracting equivalent emf for reference temperature from each value obtained.

5. IDEAL SITUATION

a. Ambient temperature during calibration should be close to ambient temperature during operation. Instrument internal temperature should be stabilized before calibration. Allow a 30 minute warm up (for greatest accuracy, on compensation actuations, allow instrument to warm up for two hours).

b. If internal temperature is disturbed when making electrical adjustments or when checking reference temperature with a mercury thermometer, internal temperature should be permitted to restabilize for 30 minutes.

CALIBRATION PROCEDURES
REBALANCING ELEMENT

SERVICE

1. GENERAL

The Electronic 16 instrument is inspected, adjusted, and calibrated before it leaves the factory. While instrument is ready for use when received, the following adjustments may be necessary from time to time.

2. ADJUSTMENTS

a. **GAIN**

(1) HI-Lo Gain Jumper. Position of gain jumper depends upon instrument span. In general, it should be connected to HI gain pin for an instrument span of less than eight millivolts; and to LO gain pin for spans of more than eight millivolts.

(2) Gain Potentiometer. Gain adjustment is required if instrument is insensitive or overly sensitive to small changes in input signals (greater than 0.1% of full scale).

b. **DAMPING.** Damping adjustment is required if pen or indicator overshoots the balance point, or if pen or indicator is slow in reaching the balance point. A recorder which is adjusted for optimum damping will draw a curve having a relatively sharp knee (depending on chart and pen speed) which breaks near balance point without overshooting balance point.

(1) If instrument overshoots balance point, turn damping potentiometer clockwise until pen or indicator approaches balance point at its greatest rate without any overshoot.

(2) If pen or indicator approaches balance point at too slow a speed, turn damping potentiometer counterclockwise to increase rate of approach without causing overshoot.

c. **ZERO.** Adjustment of zero potentiometer produces equal linear shift of all points on instrument scale without changing span of instrument. To adjust zero potentiometer, insert screwdriver in zero adjustment access hole in servo box compartment and engage zero adjustment with screwdriver tip; turn clockwise to shift all points upscale, or turn counterclockwise to shift all points downscale.

d. **SPAN.** Span adjustment provides a means of increasing or decreasing instrument span. Turn span adjustment (located through hole in the measuring circuit compartment) clockwise to decrease instrument span, or turn counterclockwise to increase instrument span.

3. CALIBRATION

a. Set up according to CALIBRATION PREPARATION (previous section).

b. Apply an input potential to drive pen or indicator to midscale position.

c. Manually turn servo shaft to drive pen or indicator more than 1% of full scale in upscale direction; allow pen or indicator to travel slowly back to balance point. Note position of pen or indicator. Manually turn servo shaft to drive pen or indicator more than 1% downscale; allow pen or indicator to travel slowly back to balance point. Note position of pen or indicator.

CAUTION: If instrument is STRANDUCER type, do not turn STRANDUCER drive pulley to unbalance drive system.

d. If differences in pen or indicator positions at the two balance points exceeds 0.1% of full scale, increase amplifier gain (turn gain adjustment clockwise) and repeat step (3) until the difference between the positions at two balance points is 0.1% or less full scale.

e. With instrument pen or indicator at midscale, apply a step change of at least 10% of full scale; adjust damping potentiometer until instrument balances in the shortest amount of time without overshooting balance point by more than 0.2% of full scale.

f. Recheck amplifier gain setting.

g. Check instrument calibration by applying voltages corresponding to several scalar points on the scale. If instrument calibration is within ±1/4% of full scale, calibration is satisfactory; if not, proceed as follows:

h. Set voltage source to a value which corresponds to midscale voltage equivalent of instrument.

i. Adjust zero potentiometer until instrument balances at midscale position.

j. Set voltage source to a value which corresponds to the voltage equivalent of the scalar point at extreme left end of instrument scale.

k. Adjust span potentiometer until instrument balances at that scalar point.

l. Continue adjusting span and zero until calibration is within ±1/4% full scale.

MEASURING CIRCUIT SERVICE

1. RANGE CHANGE

You can change instrument range by replacing the entire range card. Although service replacements are precalibrated units, minor zero and span adjustments may be required.

2. RESISTOR CALCULATIONS

This paragraph describes how the resistor values for the measuring circuit are calculated according to the range, span and type of primary element. This information is included to supplement the measuring circuit schematic diagram which does not specify any resistance values because of the many ranges available.

a. NOMENCLATURE

I_1 = The current through the upper branch of the measuring circuit, the current through R_1, R_2 and span network.

I_2 = The current through the lower branch of the measuring circuit. On millivolt and Radiamatic* unit actuations it's the current through R4 & R3

Ic = The current, on thermocouple actuations, through Rrj at 87.5°F (See Table I).

Rrj = The effective resistance of the reference junction compensation resistor assembly at 87.5°F (applies to thermocouple actuation only).

MVc = Millivoltage across Rrj at 32°F (0°C): applies to thermocouple actuation only (See Table I).

MV min = Millivoltage corresponding to 0% full scale: on the thermocouple actuations it's based on a reference junction at 0°C. MV min is often expressed as MV suppression or the displacement of 0 MV position from 0% full scale.

MV max = Millivoltage corresponding to 100% full scale: on thermocouple actuations it's based on a reference junction at 0°C.

MVs = Millivolt span (MV max - MV min).

Table I

T/C	I_c (ma)	MV_c
T	1.0934	9.7058
J	1.3797	12.2187
K	1.0768	9.5350
R	0.1610	1.4330
S	0.1610	1.4320

* Trademark Honeywell Inc.

b. FORMULAE

(1) Millivolt Actuation

(a) For spans less than 51 mv with suppression less than 30.88% of span:

$$R_1 = 500 - \frac{(317.5)\ (R5)}{317.5 + R5}$$

$$R_2 = 0$$

$$R_3 = 1000 - R_4$$

$$R_4 = (0.1544)\ (MV_s) - (0.5)\ (MV\ min)$$

$$R_5 = \frac{(317.5)\,(MV_s)}{60.240 - MV_s}$$

$$R_8 = 0$$

(b) For spans less than 51 MV with suppression greater than 30.88% of span:

$$R_1 = 500 - \frac{(317.5)\ (R_5)}{317.5 + R_5} - R_2$$

$$R_2 = (0.25)\ (MV_{min}) - (.0772)\,(MV_s)$$

$$R_3 = 1000$$

$$R_4 = 0$$

$$R_5 = \frac{(317.5)\ (MV_s)}{60.240 - MV_s}$$

$$R_8 = 0$$

(c) For spans greater than 51 MV with suppression less than 24.75% of span.

$$R_1 = 363.64 - \frac{(317.5)\ (R_5)}{317.5 + R_5}$$

$$R_2 = 0$$

$$R_3 = 4000 - R_4$$

$$R_4 = (0.5150)\ (MV_s) - (2.0)\ (MV_{min})$$

$$R_5 = \frac{(317.5)\ (MV_s)}{100 - MV_s}$$

$$R_8 = 1127$$

(d) For spans greater than 51 MV with suppression greater than 24.75% of span

$$R_1 = 363.64 - \frac{(317.5)\ (R_5)}{317.5 + R_5} - R_2$$

$$R_2 = (0.1818)\,(MV_{min}) - (.04682)\ (MV_s)$$

$$R_3 = 4000$$

$$R_4 = 0$$

$$R_5 = \frac{(317.5)\ (MV_s)}{100 - MV_s}$$

$$R_8 = 1127$$

(2) Thermocouple Actuation

(a) Spans up to 70 millivolts

(1) When MVc (Table 1) is greater than 30.88% of span:

$$R_1 = \frac{2000}{I_1} - \frac{(317.5)\ (R_5)}{317.5 + R_5} - R_2$$

$$R_2 = \frac{1}{I_1}\left[MV_{min} + MVc - (0.3088)\ (MV_s)\right]$$

$$R_3 = \frac{2000}{I_2} - 10$$

$$R_4 = 0$$

$$R_5 = \frac{(317.5)\ (MV_s)}{(I_1)\ (15.06) - MV_s}$$

$$R_8 = 0$$

(2) When MVc is less than 30.88% of span:

$$R_1 = \frac{2000}{I_1} - \frac{(317.5)\ (R_5)}{317.5 + R_5}$$

$$R_2 = 0$$

$$R_3 = \frac{2000}{I_2} - R_4 - 10$$

$$R_4 = \frac{1}{I_2}\left[-MV_{min} - MVc + (0.3088)\ (MV_s)\right]$$

$$R_5 = \frac{(317.5)\ (MV_s)}{(I_1)\ (15.06)\ -MV_s}$$

$$R_8 = 0$$

(b) Spans 70 to 100 millivolts

(1) When $MVc + MV_{min}$ is greater than 20.82% of span:

$$R_1 = \frac{2000}{I_1} - \frac{(317.5)\ (R_5)}{317.5 + R_5} - R_2$$

$$R_2 = \frac{1}{I_1}\left[MV_{min} + MVc - (0.2082)\ (MV_s)\right]$$

$$R_3 = \frac{2000}{I_2} - 10$$

$$R_4 = 0$$

$$R_5 = \frac{(317.5)\ (MV_s)}{(I_1)\ (22.698) - MV_s}$$

$$R_8 = 2187.5$$

(2) When $MVc + MV_{min}$ is less than 20.82% of span:

$$R_1 = \frac{2000}{I_1} - \frac{(317.5)\ (R_5)}{317.5 + R_5}$$

$$R_2 = 0$$

$$R_3 = \frac{2000}{I_2} - R_4 = 10$$

$$R_4 = \frac{1}{I_2}\left[(0.2082)\ (MV_s) - MV_{min} - MVc\right]$$

$$R_5 = \frac{(317.5)\ (MV_s)}{(I_1)\ (22.698) - MV_s}$$

$$R_8 = 2187.5$$

(3) Radiamatic Unit

Use formulas for millivolt actuation. When calibrating rheostat is supplied the following resistors are added:

$$R_{11} = 4166$$

$$R_P = 5000$$

(4) DC Volts and Tachometer

(a) For positive suppression greater than 30.88% of span

$$R_1 = 447.3 - R_2$$

$$R_2 = (0.25)\left(\frac{R_{11}}{R_{11} + R_{12}}\right)(V_{min}) - 0.772$$

$$R_3 = 1000$$

$$R_4 = 0$$

$$R_5 = 63.19$$

(b) For positive suppression less than 30.88% of span or for negative suppression:

$$R_1 = 447.3$$

$$R_2 = 0$$

$$R_3 = 1000\text{-}R_4$$

$$R_4 = 1.544 - (.5)\left(\frac{R_{11}}{R_{11} + R_{12}}\right)(V_{min})$$

$$R_5 = 63.19$$

(c) Voltage Divider (R_{11} and R_{12})

(1) For spans greater than 1.0 volt

$$R_{11} = \frac{10,000}{V_s - .01}$$

$$R_{12} = 1,000,000$$

(2) For spans less than 1.0 volt

$$R_{11} = \frac{1000}{V_s - .01}$$

$$R_{12} = 100,000$$

(5) DC Current

(a) For positive suppression less than 30.88% of span; and for negative suppression.

$$R_1 = 500 - \frac{(317.5)(R_5)}{317.5 + R_5}$$

$$R_2 = 0$$

$$R_3 = 1000\text{-}R_4$$

$$R_4 = (R_{11}) \left[(0.1544)\ (MA_s) - (0.5)\ (MA_{min}) \right]$$

$$R_5 = \frac{(317.5)\ (MA_s)\ (R_{11})}{60.240 - (MA_s)\ R_{11}}$$

$$R_{11} = \frac{MV_s}{MA_s}$$

(b) For positive suppression greater than 30.88% of span:

$$R_1 = 500 - \frac{(317.5)\ (R_5)}{317.5 + R_5} - R_2$$

$$R_2 = R_{11} \left[(0.25)\ (MA_{min}) - (0.0772)\ (MA_s) \right]$$

$$R_3 = 1000$$

$$R_4 = 0$$

$$R_5 = \frac{(R_{11})\ (317.5)\ (MA_s)}{60.240 - (MA_s)\ (R_{11})}$$

$$R_{11} = \frac{MVs}{MAs}$$

(6) Resistance Thermometer

(a) Circuit Parameters

I_3 = Current through Rx

Rx_{min} = bulb suppression in ohms

Rx_s = bulb span in ohms

$MV_{min} = I_3\ (Rx_{min})$

$MVs = I_3\ (Rx_s)$

(b) For spans of 1 to 10 ohms

$$R_1 = 4000 - \frac{(317.5)\ (R_5)}{(317.5) + R_5} - R_2$$

$$R_2 = 0.4 \left[(MV_{min}) - (0.2988)\ (MV_s) \right]$$

$$R_3 = R_6 - Rx_{min} - (1/2)\ (Rx_s)$$

$$R_4 = 1992$$

$$R_5 = \frac{(20.219)\ (MV_s)}{2.5 - (0.0664)\ (MV_s)}$$

$$R_6 = 4000$$

$$R_7 = 4000$$

(c) For spans 10 to 100 ohms

$$R_1 = 4000 - \frac{(317.5)\ (R_5)}{317.5 + R_5} - R_2$$

$$R_2 = 0.4 \left[(MV_{min}) - (0.2988)\ (MV_s)\right]$$

$$R_3 = 40,000$$

$$R_4 = 20,000$$

$$R_5 = \frac{(20.219)\ (MV_s)}{2.5 - (0.0664)\ (MV_s)}$$

$$R_6 = 40,000$$

$$R_7 = 4,000$$

(d) For spans of 100 to 1000 ohms

$$R_1 = 4000 - \frac{(317.5)\ (R_5)}{317.5 + R_5} - R_2$$

$$R_2 = 0.4 \left[(MV_{min}) - (0.2988)\ (MV_s)\right]$$

$$R_3 = 400,000$$

$$R_4 = 200,000$$

$$R_5 = \frac{(20.219)\ (MV_s)}{2.5 - (0.0664)\ (MV_s)}$$

$$R_6 = 400,000$$

$$R_7 = 4000$$

CONSTANT VOLTAGE CIRCUIT — SERVICE

1. OUTPUT VOLTAGE CHECK

a. Switch off instrument power. Slide chassis out to first stop and lower chart carriage to gain access to circuit unit. Remove two screws and remove servo circuit unit cover.

b. Break connections between constant voltage circuit and measuring circuit. Maintain connections to power assembly unless an independent source of 120 vac is available.

c. Construct a voltage divider network across output terminals as shown in figure 1. Use decade boxes, if available, otherwise use a pair of manganin resistors, part number 76098-999-(resistance value) or their equivalent (±0.05% tolerance). Select resistor values of 333.33 ohms (R1) and 10 ohms (R2). The total resistance (343.33 ohms) is the recommended load for the constant voltage circuit. Selecting a 10 ohm resistor for R2 results in convenient and accurate measurement of its voltage drop (60 millivolts).

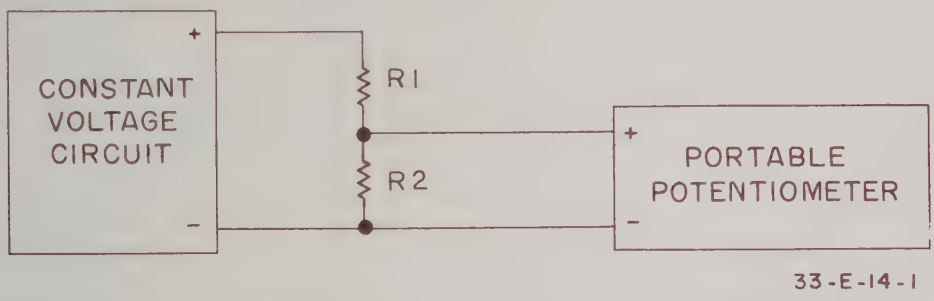


Figure 1. Constant Voltage Circuit Output Voltage Check.

TABLE I

Constant Voltage Circuit	Freq. (CPS)	Current (ma)	Output (Volts)	Load (Ohms)	Dummy Load		Voltage Across R2 (MV)
					R1	R2	
370751-1	60	6	2.060	343.33	333.33	10	60

d. Use a precision voltage source (Honeywell Series 2700 or equivalent) as a null indicating device to measure the voltage drop across R2. An error of more than 1 mv indicates the output voltage has shifted from the calibrated 2.060 volts; replace the constant voltage circuit.

2. TROUBLESHOOTING

a. GENERAL.

(1) Avoid all field repairs to the constant voltage circuit; if possible replace the entire unit. However, if troubleshooting the circuit is the only means of placing critical equipment back in service,

perform the voltage and resistance checks described in this section. Servicing is limited because the matched circuit components cannot be replaced in the field.

(2) Component locations on the printed circuit board are shown in figure 2. Check points A, B, C, D, and E are identified physically in figure 3; they are also shown schematically in figure 4.

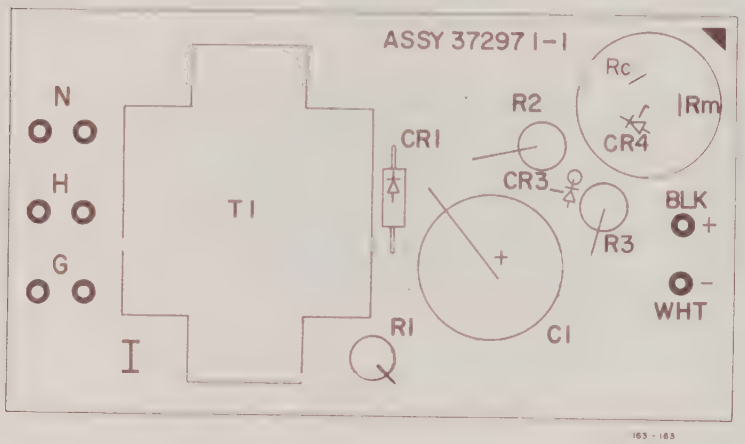


Figure 2. Constant Voltage Circuit Component Locations.

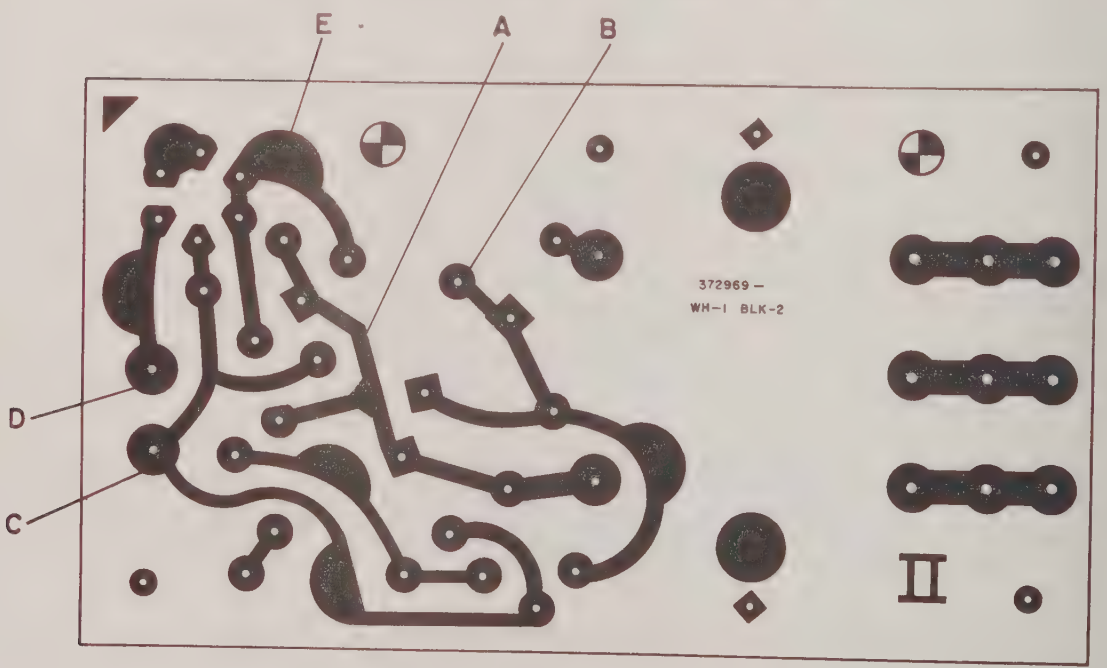


Figure 3. Constant Voltage Circuit Test Point Locations.

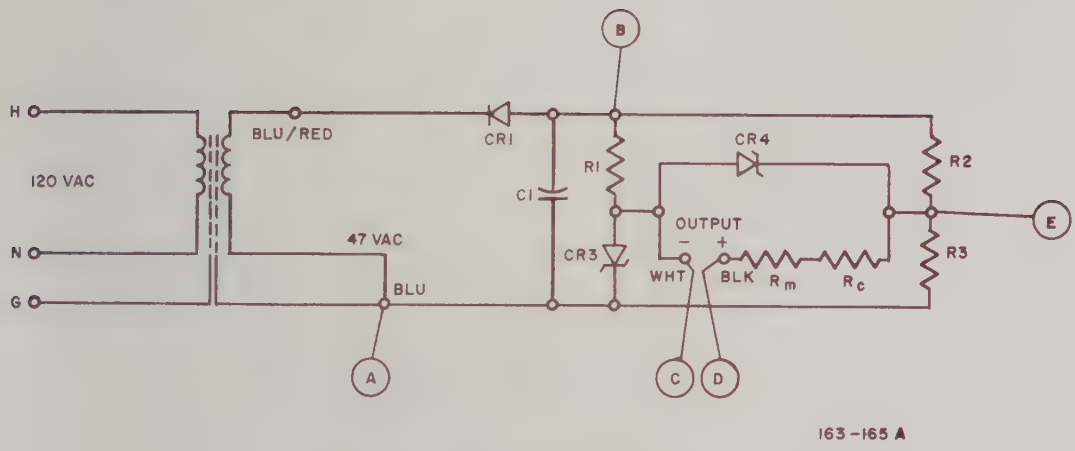


Figure 4. Constant Voltage Circuit Schematic Diagram.

b. VOLTAGE CHECKS

(1) Use same basic test set-up described for checking output voltage, but loosen mounting screws and flip circuit board over to gain access to printed wiring connections.

(2) Check voltages (per Table 2) from output of power supply secondary up to and including second stage zener diode.

TABLE 2

D. C. Volts between pts.							Component Values			
A-B	C-B	A-C	A-E	E-B	D-C	C-E	R1	R2	R3	C1
55	39	16	9.5	45.5	2.06	6.65	2100	29.4K	787	30mfd

c. RESISTANCE CHECKS

(1) Switch off instrument power and remove the printed circuit board from instrument.

(2) Discharge capacitor C1 before starting resistance checks.

(3) Use an ohmmeter to check for resistance values shown in Table 2.

d. REPAIRS

(1) CR1, CR3, C1, R1, R2, and R3 may be replaced with equivalent parts, having the same tolerance as the original.

(2) If the defective component is CR4, Rc, or Rm, however, DO NOT attempt field repairs. The values of these components are critical to the accuracy of the constant voltage circuit.

AMPLIFIER **SERVICE**

1. ADJUSTMENTS

a. GAIN ADJUSTMENT. If the amplifier is insensitive to small changes in input signals, increase the gain by turning the gain adjustment clockwise. Decrease gain if continuous oscillation occurs.

b. DAMPING ADJUSTMENT. Damping adjustment is required if the recording device overshoots the balance point, or if it is too slow in reaching the balance point. A recorder which is adjusted for optimum damping will draw a curve having a relatively sharp knee (depending on chart and pen speed) which breaks near the balance point without overshooting the balance point.

(1) If an instrument overshoots its balance point, increase damping (turn adjustment clockwise) until recording device approaches balance point at its greatest rate without objectionable overshoot.

(2) If recording device approaches balance at too slow a speed, reduce damping (turn adjustment counterclockwise) to increase approach rate without causing overshoot.

2. PROCEDURE

NOTE: The yellow wire of the input cable is the ungrounded side of the input; and the blue, grey, orange, and brown wires must be connected together as the ground side of the input.

a. Set gain pot to extreme clockwise position and place gain option jumper (where applicable) in HIGH position. In all Class 16 amplifiers, the position of the damping pot has no effect.

b. With the rotor free to turn, make the following checks:

Check 1. - Zero Offset

The input shall be adjusted to stop motor rotation. This input (zero offset) shall not exceed ± 10 microvolts. Retain this zero offset signal in all subsequent checks.

Check 2. - Dead Band

Apply, in turn, large plus and minus input signals, reducing each until the motor just stops, and noting the input signal values. The difference of these two values shall not exceed 2 microvolts.

c. Block the rotor, and make the following checks:

Check 3. -Prop. Band Hi Gain

Plus and minus input signals required to produce 4.5 v-ac on the motor control winding shall be no more than 20 microvolts.

Check 4. - Motor Saturation Voltage Hi Gain

When input signals of ± 40 microvolts are applied, the motor control winding voltage shall be at least 7.0 v-ac.

d. Place gain option jumper in LOW position (where applicable), and make the following checks:

Check 5. - Prop. Band Lo Gain

Plus and minus input signals required to produce 4.5 v-ac on the motor control winding shall be at least 10 microvolts, but no more than 40 microvolts.

Check 6. - Motor Sat. Voltage Lo Gain

When input signals of ± 200 microvolts are applied, the motor control winding voltage shall be at least 6.5 v-ac.

e. Return gain option jumper to HIGH position.

3. TROUBLESHOOTING

a. Before starting a systematic analysis of the power, amplifier, and input assemblies, make the following checks to eliminate obvious sources of trouble. (See schematic diagram.)

(1) Check line power on the power board.

(2) Be sure that input plug and all terminals of the 5-wire output cable are properly inserted and that all straight pin connections on the printed wiring boards are making contact.

(3) Be sure the converter and converter plug are held in place by the spring clamp.

(4) Look carefully for broken wires, broken resistors, burned parts, and burned or open connections on the bottom of the printed circuit panels.

(5) Be sure that the servo motor is free to return.

b. Make following checks of "probable causes" on the basis of instrument performance.

CAUTION: Regardless of the selected troubleshooting method, transistor checks and replacements must only be attempted by personnel familiar with transistor servicing techniques.

(1) NO DRIVE

(a) Check C1 and C2 for opens or shorts.

(b) Inspect all connections between the amplifier sub panels.

(c) Check the power transistor Q5, and diode CR5.

(2) DRIVE IN ONE DIRECTION

(a) Check diodes CR3 and CR4.

(b) Check the yellow to yellow-black, and the yellow to yellow-green windings of transformer T1 for continuity.

(3) INSENSITIVE

(a) Check capacitor C14.

(b) Check transistors Q4 and Q5.

(c) Check diode CR5.

(d) Check transformer T3 for continuity and proper winding resistance. The primary resistance should be 1450 ± 200 ohms, and the secondary should be 22 ± 4 ohms.

4. SERVICING DATA

a. The d-c voltages in table 1 are measured with respect to circuit common using a 20,000 ohm/volt meter. A schematic diagram should be consulted to make proper use of the readings given. The readings are in three groups. If a reading is bad in a particular group, check the parts and connections of all parts in that group before proceeding.

b. Short the input before reading any d-c voltage, because they are affected by signal and/or stray voltage levels. If using an oscilloscope, all voltages except those on CR8 and CR9 should be smooth d-c. The voltages on CR8 and CR9 should be a full wave rectified sine of about 28 volts peak at a nominal 120 V rms. line voltage.

c. If the power amplifier is removed or disconnected for any reason, a 1200 ohm 1/2-watt composition resistor may be used in place of T-3 as a load on Q7. This will assure proper distribution of currents and voltages. No damage will result if it is not used, however.

d. If all d-c voltage levels are correct, it is most probable that the amplifier will perform correctly. It may still be interesting or useful, however, to check the signal waveforms shown in table 2.

e. All waveform measurements are made with the amplifier assembled in its case, with the case grounded, and with the gain pot and gain jumper in their high gain positions. A d-c input of 10 millivolts applied through the standard input filter should produce the shown Q1 through Q4 waveforms. The yellow wire of the input cable is the ungrounded side of the input; and the blue, grey, orange, and brown wires are connected together as the ground side of the input.

TABLE 1. VOLTAGE CHECKS

AMPLIFIER SECTION		d-c VOLTS
POWER SUPPLY (Group 1)		
Rectifiers:	CR8 & CR9	20 ± 2
	CR6	8.2 ± 1
Zener Diodes	CR6 & CR7	17 ± 2
	CR5	12 ± 1.5
	CR10	7.8 ± 1
Q1 THRU Q3 (Group 2)		
Q1	V_{SD}	2.6 to 7.5
Q2	V_B	1.3 ± .3
	V_E	0.75 ± .3
Q3	V_E	0.1 ± 0.03
	V_C	1.45 ± 0.4
Q4 THRU Q7 (Group 3)		
Q4	V_B	0.65 ± .2
	V_E	.005 ± .001
Q5	V_B	1.0 ± .2
	V_E	0.6 ± .1
Q6	V_B	2.0 ± .4
	V_E	1.2 ± .2
Q7	V_B	8.0 ± 1.4
	V_E	7.5 ± 1.5

TABLE 2. WAVEFORMS Q_1 TO Q_4

Q1	V_{GATE}	Chopper Spikes 10 MV
	V_{SD}	Same shape as V_G but 1 to 10 times larger.
Q2	V_B	Same amplitude as V_{SD} but with slope.
	V_E	Same as V_B but between 0.6 and 0.9 times amplitude.
Q3	V_B	Same as V_E of Q2.
	V_C	Should be between 150 and 300 MV p-p.
Q4	V_B	Same as V_C of Q3.
	V_C	0.8 to 1.2 V p-p. The chopper spikes are gone because the stage is saturated.

f. The waveforms from Q5 collector through Q7 are fully saturated rectangular signals of approximately the magnitudes as listed in table 3. This set of data is indicative of proper stage biasing and of good parts in general, but can not give an indication of gain.

TABLE 3.

Node	Volts peak to peak
Q5 Collector	2.0 ± 0.5
Q6 Base	Same as Q5 Collector
Q6 Collector	14.5 ± 2
Q7 Base	Same as Q6 Collector
Q7 Emitter	14.0 ± 2

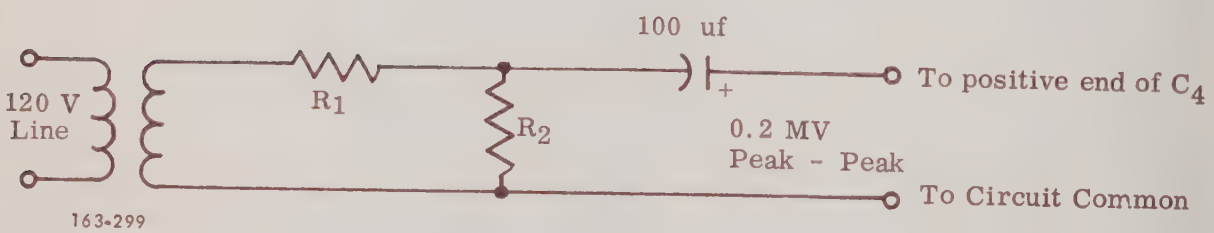


Figure 1. 60 cps. Millivolt Source for Waveform and Gain Check.

g. To obtain an indication of gain and distortion in the Q4 through Q7 stages, open C4 on the positive end and apply a 0.2 millivolt, peak to peak, 60 cps signal between C4 and circuit common. Figure 1 is a simple circuit to accomplish this purpose. The waveforms and voltages are shown in table 4.

TABLE 4. WAVEFORMS Q_4 TO Q_7

Q4	V_B	0.2 MV_{pp}.
	V_C	2 to 3 MV_{pp}.
Q5	V_B	Same as V_C of Q4
	V_C	100 to 120 MV_{pp}.
Q6	V_B	Same as V_C of Q5
	V_C	4 to 6 V_{pp}.
Q7	V_B	Same as V_C of Q6
	V_E	Same as V_B less 0.5 Volt

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h. The nominal d-c current in each stage is shown in table 5. The average current drawn by Q1, Q2, and Q3 is 1.0 Ma., and since the power supply node feeding power to these stages is a nominal 8.2 Volts, these stages present an equivalent 8.2K ohm load hereafter called R_{L1}. The nominal current drawn by Q4 and Q5 is 0.23 Ma at a power supply node voltage of 12.0 volts, which gives an equivalent load resistance of 52K ohms hereafter called R_{L2}. The nominal current drawn by Q6 and Q7 is 6.6 Ma at a supply voltage of 17 volts yielding an equivalent load of 2.6K ohms hereafter called R_{L3}. Thus, the d-c. power supply may be shown as follows with the amplifier loads R_{L1}, R_{L2}, and R_{L3}.

TABLE 5.

STAGE	CURRENT PATH	D.C. CURRENT
Q1	I_D	70 - 560 μa
Q2	I_C	75 μa
Q3	I_C	0.68 Ma
Q4	I_C	110 μa
Q5	I_C	122 μa
Q6	I_C	0.9 Ma
Q7	I_C	5.7 Ma

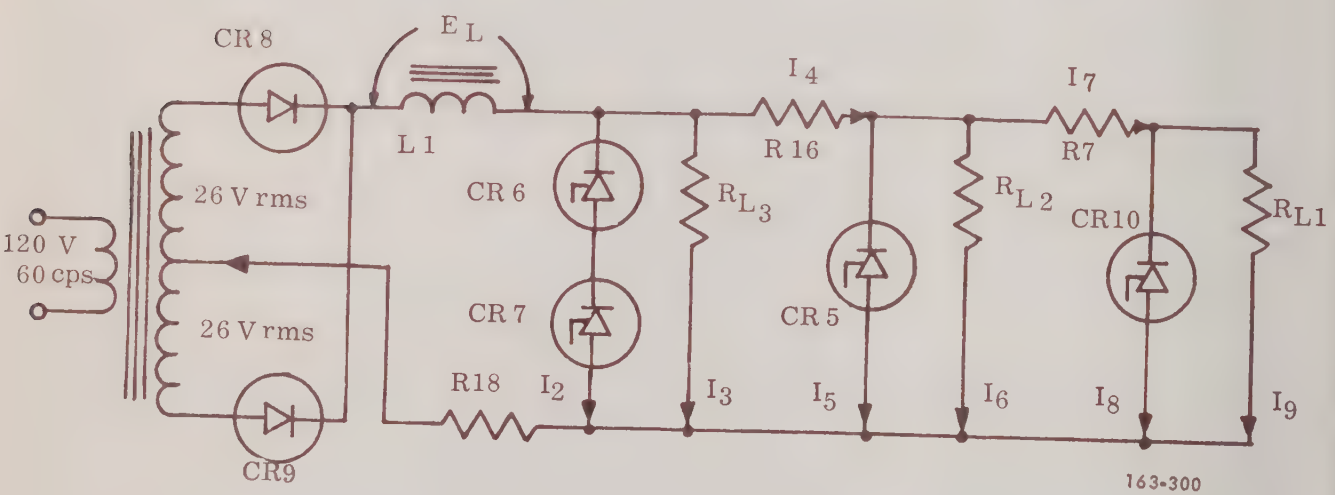


Figure 2. d-c Power Supply Circuit

i. The voltage E_L appearing on L1 is a full-wave rectified signal about 28 volts peak to peak, and would appear like Figure 3 on a scope display. If E_L is read with a multimeter, it will register the average of this wave which is about 3 volts d-c.

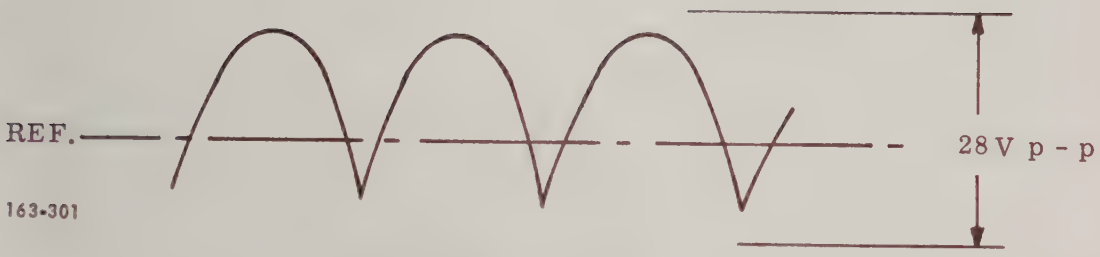


Figure 3. Signal E_L Appearing across L1

TABLE 6. NOMINAL d-c CURRENTS IN THE POWER SUPPLY

CURRENT NUMBER	CURRENT IN Ma.
I_1	25.0
I_2	10.0
I_3	6.6
I_4	8.5
I_5	4.3
I_6	0.23
I_7	4.0
I_8	3.0
I_9	1.0

1. BASIC TYPES

a. Honeywell motors used for chart drive and servo balancing functions are classified into three basic types; reversible induction motors, low voltage induction motors, and synchronous motors.

b. The most common motors are listed in Table 1 below, along with the part numbers of that type. Using this base part number it is possible to identify the motor type and help insure proper servicing of the motor. Motor part numbers and other operational data are stamped on the motor nameplate.

TABLE 1 - MOTOR TYPES

PART NO.	MOTOR TYPE	TEST DIAGRAM	APPLICATION
362479-Item No. 362480-Item No.	Reversible Induction	Fig. 1, 2	Servo and Balancing Drives
365754-Item No. 365755-Item No.	Low-Voltage Induction	Fig. 1, 2	Servo and Balancing Drives
362481-Item No.	Synchronous	Fig. 1	Uni-directional Timing Drives

c. The item number of a motor identifies its particular characteristics such as: speed of rotation (rpm's), torque, gear ratios, etc. The item number is also used to identify the proper replacement parts required for each motor as listed in the motor parts list, or when ordering parts from Honeywell Inc.

2. SERVICE TESTING

a. Synchronous and induction type motors have two phase windings. The control phase winding is identified by the red and green (or red and violet) motor leads; the line phase winding by the yellow and white leads.

b. To test Honeywell motors, make electrical connections to the motor as indicated in Table 2. Proper test diagrams are listed in Table 1.

c. To make D.C. resistance measurements of the phase windings, connect a VTVM (or VOM) to leads as tabulated in Table 3. (Listed resistance measurements made at 75°F ±5°).

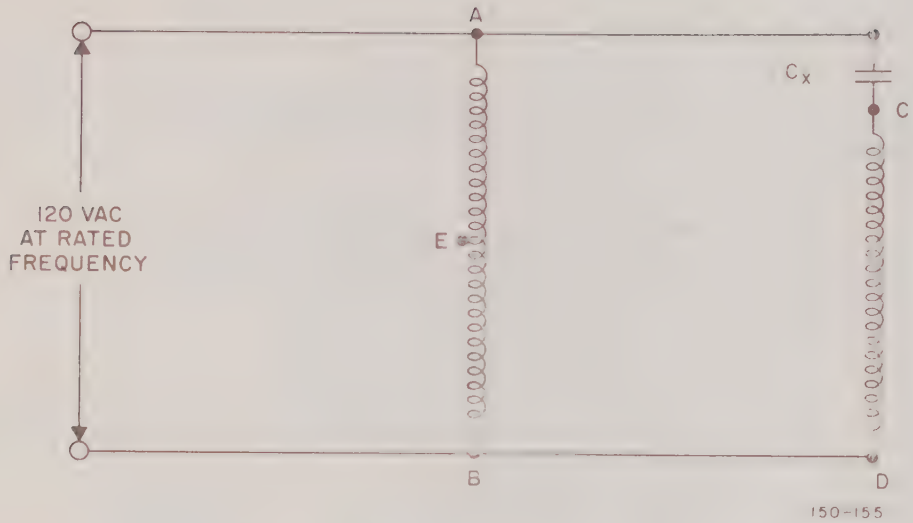


Figure 1. Electrical Bench Test - Honeywell Motors.

TABLE 2 - BENCH TEST LEAD CONNECTIONS

MOTOR NO.	A	B	C*	D*	E
362479-1,8,10 & 11	RED	GREEN	YELLOW	WHITE	-
362479-2 to 7,9	RED	GREEN	WHITE	YELLOW	-
362480-1 to 3	RED	GREEN	WHITE	YELLOW	-
365755-1,3 & 4	RED	GREEN	WHITE	YELLOW	-
365755-5,6	RED	VIOLET	WHITE	YELLOW	BLUE
365754-1 to 12, 15	RED	GREEN	WHITE	YELLOW	-
365754-13 & 14	RED	GREEN	YELLOW	WHITE	-
362481-1,9,13 to 16	RED	GREEN	YELLOW	WHITE	-
362481-2,3,7,8,10 to 12 or 17	YELLOW	WHITE	RED	GREEN	-
362481-4 or 5	YELLOW	WHITE	RED	GREEN	-
362481-6	WHITE	YELLOW	RED	GREEN	-

*NOTE: Capacitor Cx is 1 mfd., 330V, except for motors numbered 362481-4 or 5 which require 2 mfd., 330V. Rotation should reverse by interchanging C and D except on synchronous motors (362481-item no.) which are uni-directional.

d. When the leads in the power cable are connected as shown in Figure 1, the motor pinion gear will rotate in a clockwise direction when viewed from the pinion end.

e. To test the control winding of reversible induction and low voltage induction type motors, connect the motor in the circuit shown in Figure 2.

NOTE: Allow motor to cool to room ambient or 75°F for 1 hour prior to test.

f. With 120 Vac (±3v), at the motor's rated frequency, applied to the line winding (yellow and white leads), slowly increase, from zero volts, the voltage on the control winding (red and green, or red and violet leads) by changing the variable autotransformer setting. Continue increasing the voltage until the motor pinion starts to rotate and continues rotating. Now, very slowly decrease this voltage until the motor just stalls.

g. Again, slowly increase the voltage until the pinion just starts to rotate and continues rotating. Measure the voltage across the control winding (red and green leads). For proper performance this voltage should be:

(1) 15.00 volts or less for reversible induction motors

(2) 0.75 volts or less for low voltage induction motors

(3) 1.5 volts for low voltage induction motors numbered 365775-5 and 6.

(4) 20 volts or less for induction motors with a rated frequency of 25 Hz.

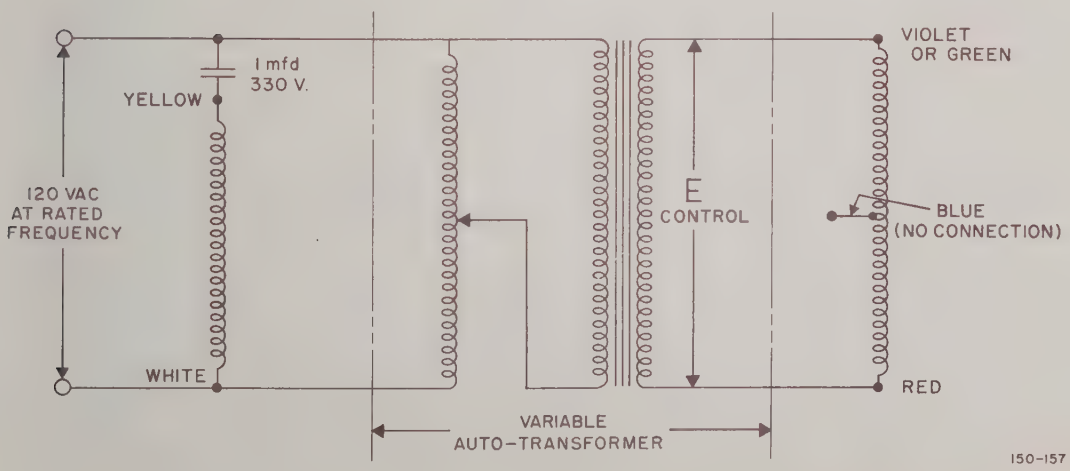


Figure 2. Control Winding Voltage Test.

TABLE 3 - D.C. RESISTANCE MEASUREMENTS (OHMS)

Honeywell Motor Part No.	Red and Green Leads		Yellow and White Leads		Violet and Blue Lead	
	Min.	Max.	Min.	Max.	Min.	Max.
362479-1,2,3,6,8 to 11	450	550	450	550		
362479-4,5,7	1800	2200	1800	2200		
362480-1 and 3	450	550	450	550		
362480-2	1800	2200	1800	2200		
365754-item no.	3.2	3.9	450	550		
365755-1 to 4	3.2	3.9	450	550		
365755-5,6	16	20	450	550	8	10
362481-1 or 9,13 to 16	110	140	450	550		
362481-2,3,10,11 or 17	450	550	300	360		
362481-4,5	1100	1400	450	550		
362481-6	450	550	450	550		
362481-7,8, or 12	450	550	300	360		

3. LUBRICATION

a. Honeywell motors are factory lubricated for the life of the motor. A special synthetic oil that is not compatible with ordinary petroleum oil is used. It is recommended that substitute oils not be used. If internal lubrication becomes necessary as a result of motor disassembly and cleaning, CARE* TYPE 321 oil (Honeywell Spec. B-2684) should be used for re-lubrication of the motor.

NOTE: Lubricants should never be mixed. Replacement oils should be the same kind as used in the original lubrication. If this is not possible, the motor must first be thoroughly cleaned, new felt pads (part no. 362486) installed and saturated with a high grade instrument oil.

b. The motor ball bearings are grease packed and need not be lubricated.

*Tradename - Care Laboratories

4. SERVICING

a. **DISASSEMBLY.** The Honeywell motor, shown in Figure 3, consists of five major sub-assemblies; namely, the gear housing assembly (A) the front bearing assembly (B), the armature assembly (C) the stator assembly (D), and the end bell assembly (E). To disassemble, proceed as follows:

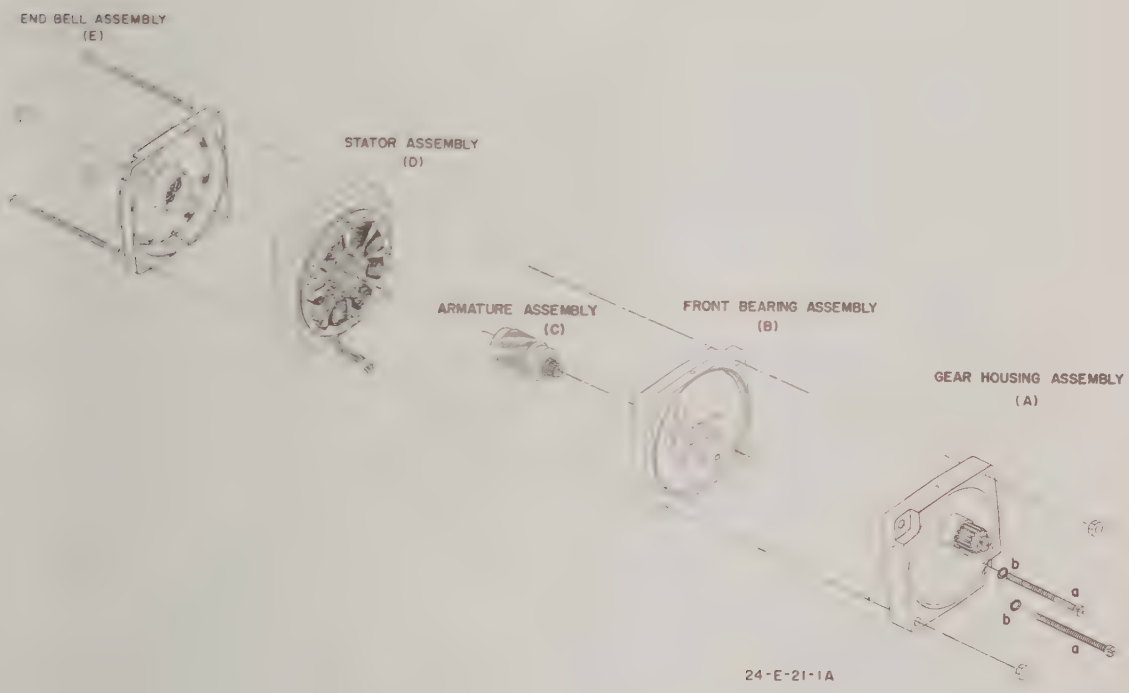


Figure 3. Exploded View, Typical Honeywell Motor.

(1) Remove the two assembly screws (a) and related washers (b).

(2) Lift off the gear housing, the front bearing housing, the armature assembly and the stator assembly. (Note orientation of the stator assembly and end bell assembly prior to disassembly; reassemble as originally positioned.)

(3) The motor has been disassembled as far as is normally necessary for replacement of defective parts or for cleaning and lubrication.

(4) A special tool kit (364950) is available for reversible induction and low voltage induction type motors that allows further disassembly of the subassemblies.

(5) Reassembly procedures are the reverse of disassembly procedures.

b. INSPECTION

(1) Inspect all metal parts for cracks or excessive wear; replace all defective parts.

(2) Inspect gear teeth for defects, such as, chipping and galling; replace defective gears.

(3) Inspect bearings for dirt, and for side and end play. A slight amount of end play is permissable, but not more than 0.020 inch axial motion. Replace bearings if defective or noisy.

(4) Inspect stator field coils for traces of overheating or shorting, shown by a marked discoloration or burn marks on the coil. Replace field coil assembly if defective.

c. CLEANING

(1) All metal parts (except ball bearings or needle bearings) can be cleaned with dry-cleaning solvent.

(2) When cleaning the exposed armature bushing surface, dip in dry-cleaning solvent and brush with a soft brush.

SLIDEWIRE **SERVICE**

1. COMMENT

If there is persistent trouble with the slidewire, the entire assembly should be replaced.

2. EXPOSE SLIDEWIRE

a. Open instrument door (or remove it).

b. Raise chassis release bar and slide chassis forward to first stop.

c. Loosen knurled retaining screws on either end of chassis dust cover (top of chassis), and swing cover upward to gain access to cabling system.

d. Swing chart transport down and forward (release latch is on right hand forward edge of chassis).

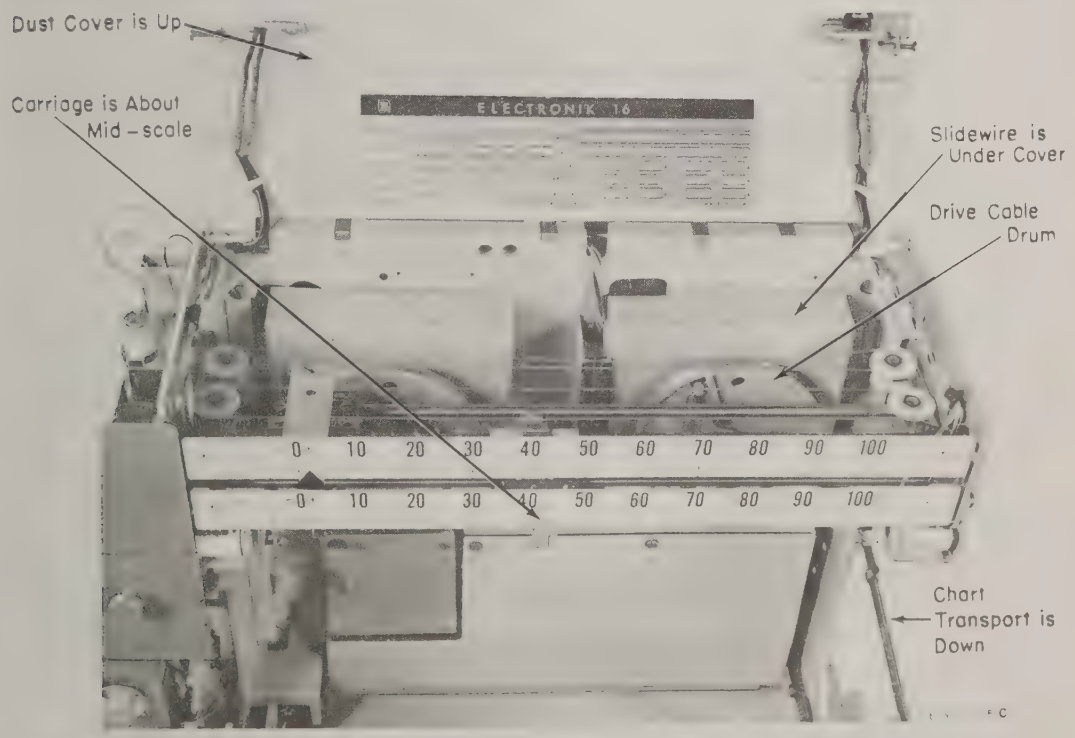

Dust Cover is Up
Carriage is About Mid-scale
ELECTRONIK 16
Slidewire is Under Cover
Drive Cable Drum
0 10 20 30 40 50 60 70 80 90 100
0 10 20 30 40 50 60 70 80 90 100
Chart Transport is Down

Fig. 1 TO EXPOSE SLIDEWIRE (Typical 2 pen instrument shown)

3. REMOVE OLD ASSEMBLY

a. Remove slidewire cover.

b. Position indicator carriage approximately mid-scale to expose set screw located immediately behind drive cable drum.

c. Unhook spring loaded end of drive cable from cable drum, then remove other end of cable (reverse sequence of Fig. 3). DO NOT UNCLAMP CABLE AT INDICATOR CARRIAGE, otherwise realignment will be necessary.

d. Loosen set screw and slip drum from servo drive shaft.

e. Observe and make note of wire color locations to slidewire connectors.

f. Disconnect wires from slidewire terminals by grasping the "lug" or connector of each wire. DO NOT PULL ON THE WIRE ITSELF, as this may strip wire from connector.

g. Remove three mounting screws which attach slidewire to chassis.

h. Slide assembly out over shaft taking care to slip the disconnected wires through access hole in the slidewire frame.

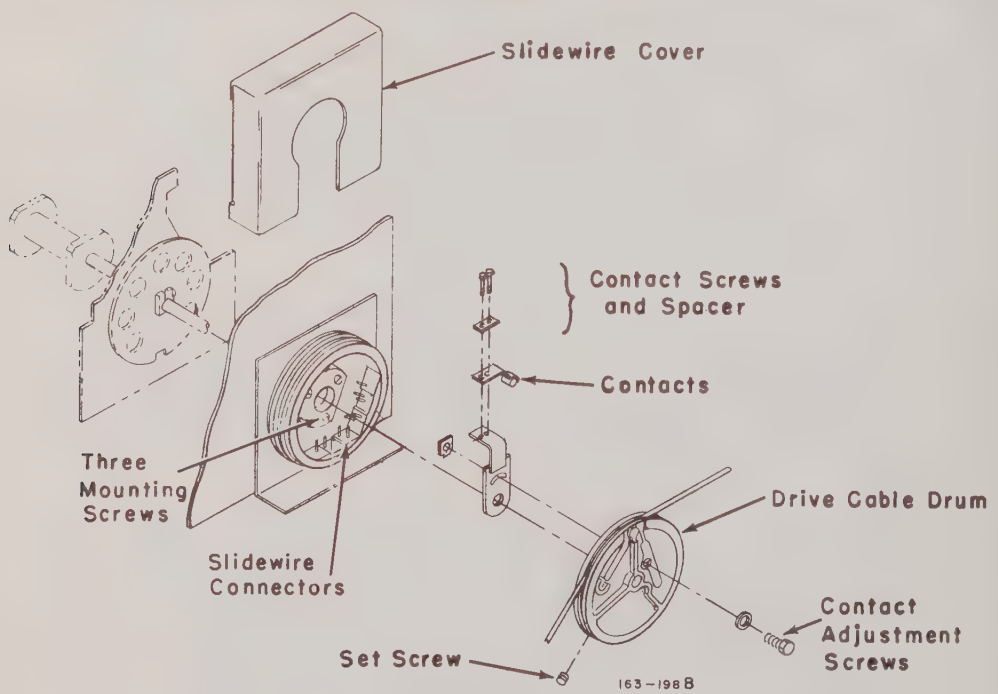


Fig. 2 TYPICAL SLIDEWIRE ASSEMBLY

4. INSTALL NEW ASSEMBLY

a. Slide new slidewire over shaft feeding wires through access hole in assembly.

b. Loosely attach the slidewire assembly to chassis with three mounting screws. Only one position is possible because of the triangular position of the screw holes.

c. Slide tapered alignment "bushing" over shaft with large diameter toward the chassis, inserted into center hole of the slidewire assembly.

d. While pressing alignment bushing against chassis, tighten mounting screws.

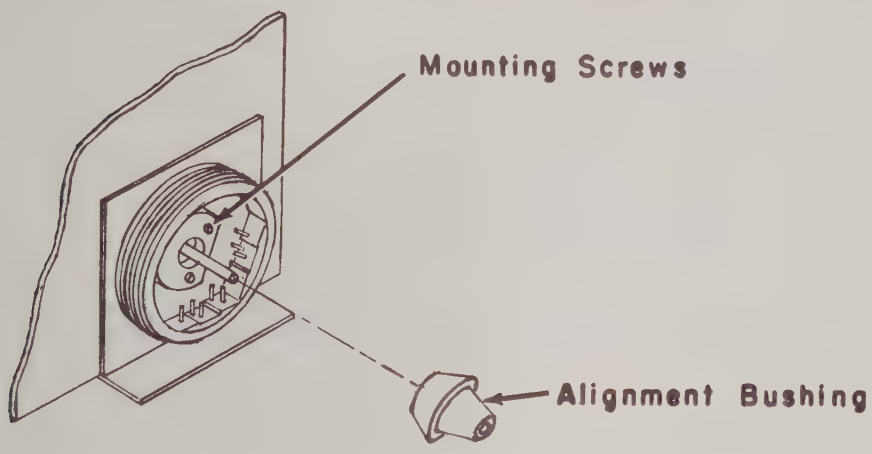


Fig. 3 SLIDEWIRE FORM ALIGNMENT

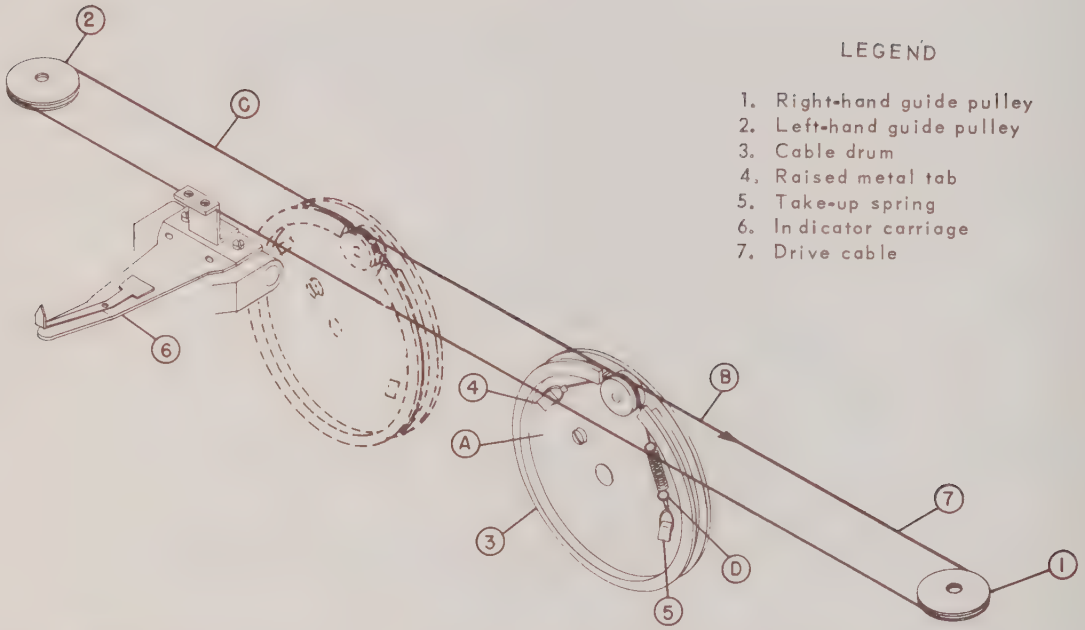
e. Replace cable drum assembly. To guide slidewire contacts over resistor and collector, slip a thin piece of cardboard or shimstock between them. DO NOT "SNAP" CONTACTS AGAINST RESISTOR or COLLECTOR as this may dent the windings.

f. Tighten set screw on cable drum at the point where contacts are centered over resistor.

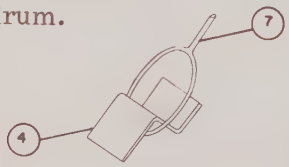
g. Keyway on servo shaft should insure proper alignment along circumference of the resistor. To check, rotate drum to clockwise end of the slidewire; the contacts should be close to zero position "terminal" but not on soldered joint. Mechanically adjust if necessary.

h. Reinstall drive cable by first hooking plain loop, then sprung end of cable.

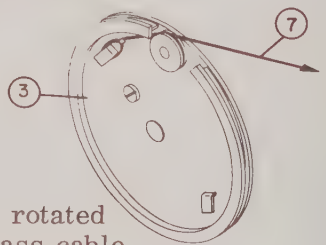
i. Make any necessary final adjustment using electrical zero adjustment on servo unit



A Place one end of drive cable (large loop) over the raised metal hook on the cable drum.

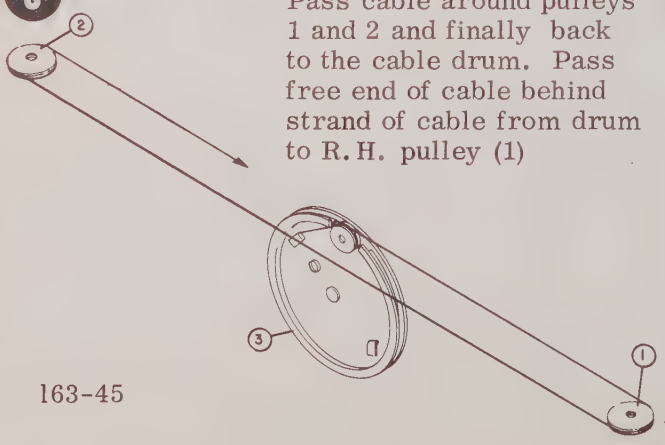


B



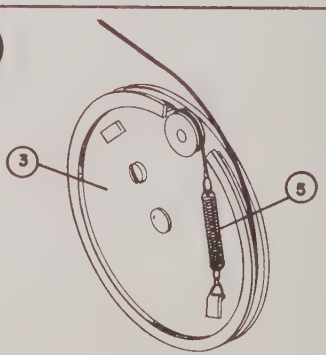
With cable drum rotated full clockwise, pass cable from top of drum to R. H. guide pulley (1).

C Pass cable around pulleys 1 and 2 and finally back to the cable drum. Pass free end of cable behind strand of cable from drum to R. H. pulley (1)



163-45

D



Pass cable once around the drum and hook the free end (small loop) to the tension take-up spring.

Fig. 4 CONNECTING CABLE

646-0006-163

5. REPLACING CONTACTOR ASSEMBLY

a. If slidewire contactor assembly is severely worn, replace assembly.

b. Remove two screws which secure contactor assembly to wiper arm assembly.

c. Retain screws and rectangular spacer. Discard worn assembly.

d. Mount new contact assembly onto wiper arm.

e. Push assembly fully to the left (against bend of contact) on wiper arm before tightening screws.

f. Check that contacts are centered to ride on top of slidewire throughout full travel. If necessary, loosen cable drum setscrew to center contacts.

g. Rotate cable drum against clockwise stop. Contact should be set as close to zero resistance as possible without resting on solder. Loosen clamping screws to adjust.

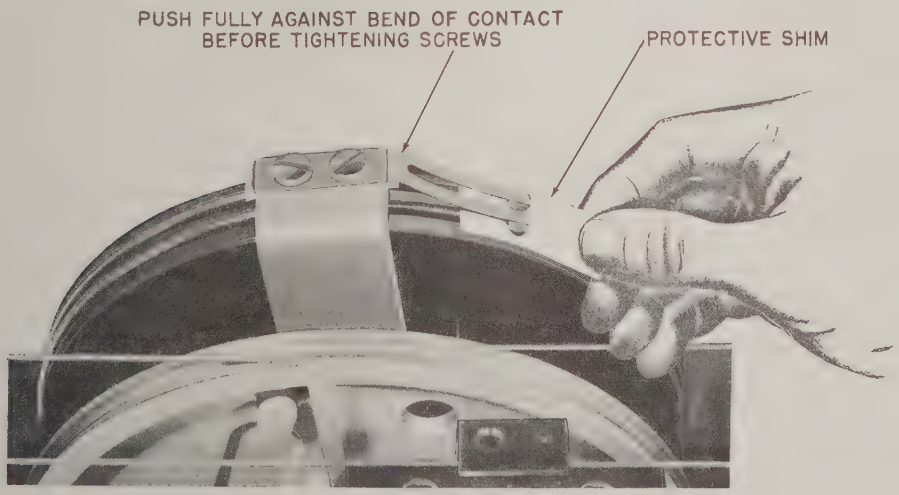


Fig. 5 SLIDEWIRE MOUNTED

6. ADJUSTING CONTACT PRESSURE

a. Legs of contact should be bent 51° from shank when not under load.

b. Each leg should deflect 1/8 inch under a load of 60±8 grams.

c. Rotate drum throughout full travel to insure complete contact along entire length of slidewire.

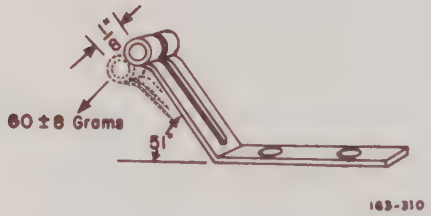


Fig. 6 SLIDEWIRE CONTACT

1. DRIVE CABLE

a. EXPOSE CABLE

(1) Open instrument door (or remove it).

(2) Raise chassis release bar and slide chassis forward to its first stop. Turn rebalancing drive gear until indicator carriage is at its lower (left-hand) limit of travel.

(3) Loosen knurled retaining screws on either end of chassis dust cover (top of chassis), and swing cover up to gain access to the cabling system.

(4) Swing chart transport down and forward (release latch is on right-hand forward edge of chassis).

b. REMOVAL

(1) Loosen retaining screws on indicator carriage and free cable from this assembly. If the instrument has an auxiliary drive shaft assembly, free cable from driven cable drum (loosen retaining screws in cable clamp).

(2) Unhook spring-loaded end of drive cable and pass cable around guide pulleys (figure 1).

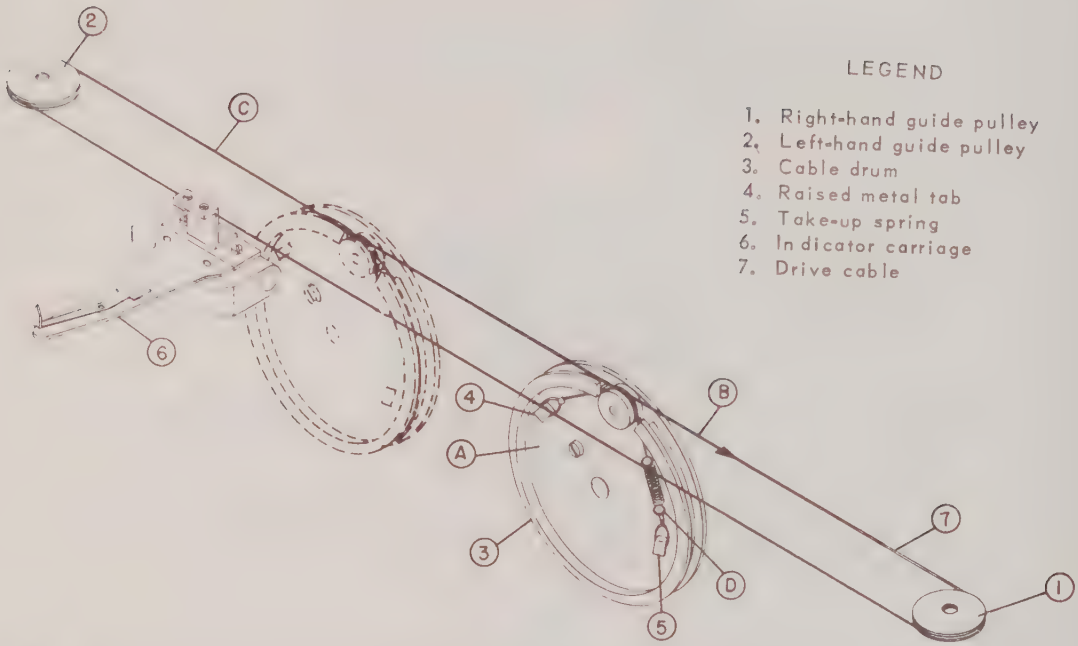
(3) Slip other end of the cable off raised metal hook on cable drum. Remove cable carefully; avoid kinking.

c. INSTALLATION

(1) Turn cable drum clockwise until drive gear hits limit stop. Install drive cable as shown in figure 1, but not the following exceptions:

(a) On instruments with an auxiliary drive shaft assembly (for auxiliary alarm or control features), wrap the drive cable around the driven cable drum (1 turn). Clamp the cable to the drum after aligning the auxiliary system as specified later in this manual.

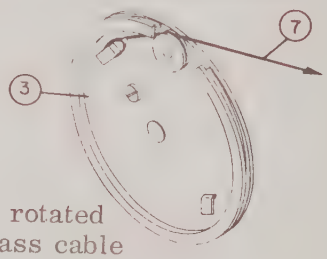
(b) On two-pen instruments the drive cable for lower pen servo (red-pen) passes around four guide pulleys. Upper pen servo (purple pen) requires the free end of the cable (step C) to pass in front of the cable strand going to the right hand pulley.



A

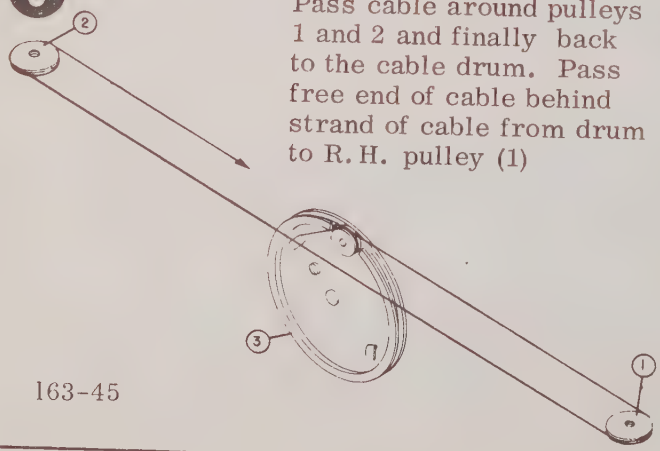
Place one end of drive cable (large loop) over the raised metal hook on the cable drum.

B



With cable drum rotated full clockwise, pass cable from top of drum to R. H. guide pulley (1).

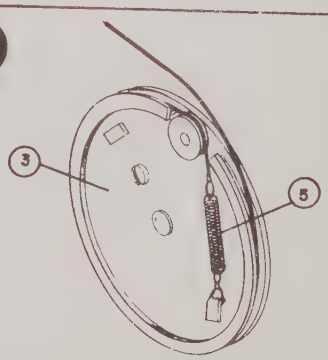
C



Pass cable around pulleys 1 and 2 and finally back to the cable drum. Pass free end of cable behind strand of cable from drum to R. H. pulley (1)

163-45

D



Pass cable once around the drum and hook the free end (small loop) to the tension take-up spring.

Figure 1. Drive Cable Installation

(2) Set the indicator carriage to its lower limit of travel, place the cable within the clamp, and tighten the retaining screw.

(3) Before placing the instrument back in service, check alignment of pointer and scale at both ends of travel and readjust if necessary.

2. ALIGNMENT

a. CHECK

(1) Check alignment of indication system and adjust (if necessary) at side of chart with round holes. For convenience of this description, assume that round holes are on right-hand side of chart, and elognated holes (for humidity compensation) are on left.

(2) With chart installed, manually move indicator carriage (turn drive-gear) to the right until indicator points to extreem right-hand scale graduation, or to another appropriate graduation (near right-hand end of scale) if instrument is equipped with a right-hand event marker pen.

(3) On single-record instruments, pen tip should coincide with appropriate chart graduation. On multirecord instruments, vertical line of + symbol should print on appropriate chart graduation.

(4) On two-pen instruments, repeat alignment check on the second pen system.

b. CARRIAGE Align indicator carriage with respect to chart as follows:

(1) Loosen retaining screws on chassis dust cover and swing cover up to gain access to the indicator carriage.

(2) Loosen carriage cable clamp and reposition indicator carriage as required to align recording device with appropriate chart graduation.

(3) Be sure cable is in slot of cable clamp, tighten clamp and close dust cover.

(4) On two-pen instruments, repeat carriage alignment, if necessary, for second pen.

c. SCALE Align scale with indicator carriage as follows:

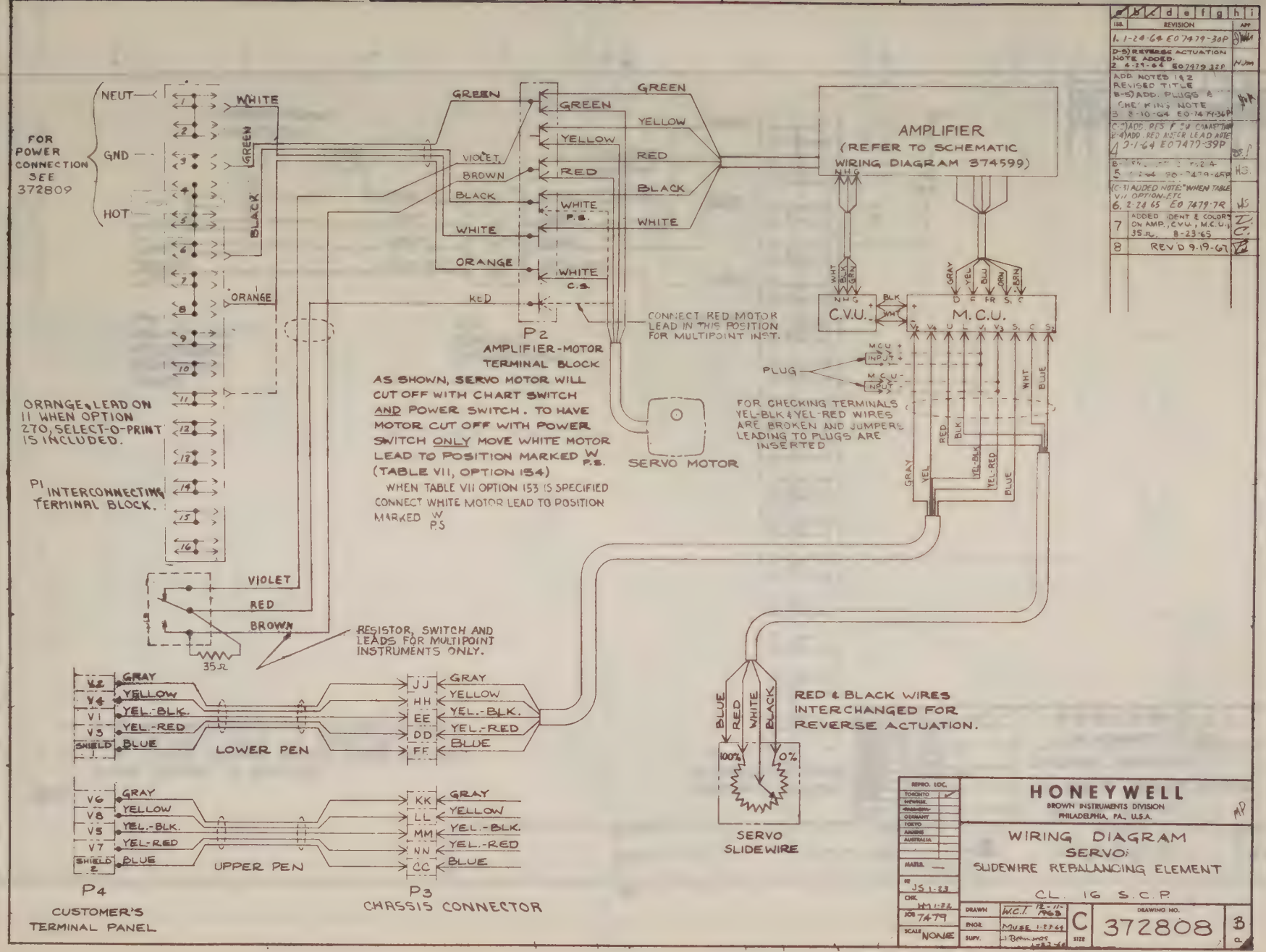
(1) Move indicator carriage to line up recording device and extreme right-hand chart graduation.

(2) Loosen screws which secure scale and shift scale until appropriate graduation lines up with pointer; tighten screws.

(3) Move indicator carriage to line up recording device and extreme left-hand chart graduation. Appropriate scale graduation should line up with pointer within 0.01 inch.

(4) On tow-pen instruments repeat alignment procedure for second pen system.

REFERENCE DRAWINGS



LTR.	REVISION	APP'D
1.	1-24-64 E07479-30P	
D-5)	REVERSE ACTUATION NOTE ADDED. 2 4-29-64 E07479-32P	
	ADD NOTES 1 & 2 REVISED TITLE B-5) ADD. PLUGS & CHECKING NOTE 3 8-10-64 E07479-36P	
C-3)	ADD. RES. & SW CONNECTION E-4) ADD. RED MOTOR LEAD NOTE 4 2-1-64 E07479-39P	
B-	[illegible]	
5	[illegible] E07479-42P	
(C-3)	ADDED NOTE: "WHEN TABLE VII OPTION-ETC 6. 2 28 65 E07479-7R	
7	ADDED IDENT & COLORS ON AMP., C.V.U., M.C.U., 35Ω, B-23-65	
8	REV'D 9-19-67	

REPRO. LOC.
TORONTO
NEWARK
[illegible]
OSSINING
TOKYO
AMHERST
AUSTRALIA
MATER. —
DR JS 1-23
CHK. MM 1-23-
JOB 7479
SCALE NONE

HONEYWELL
BROWN INSTRUMENTS DIVISION
PHILADELPHIA, PA., U.S.A.

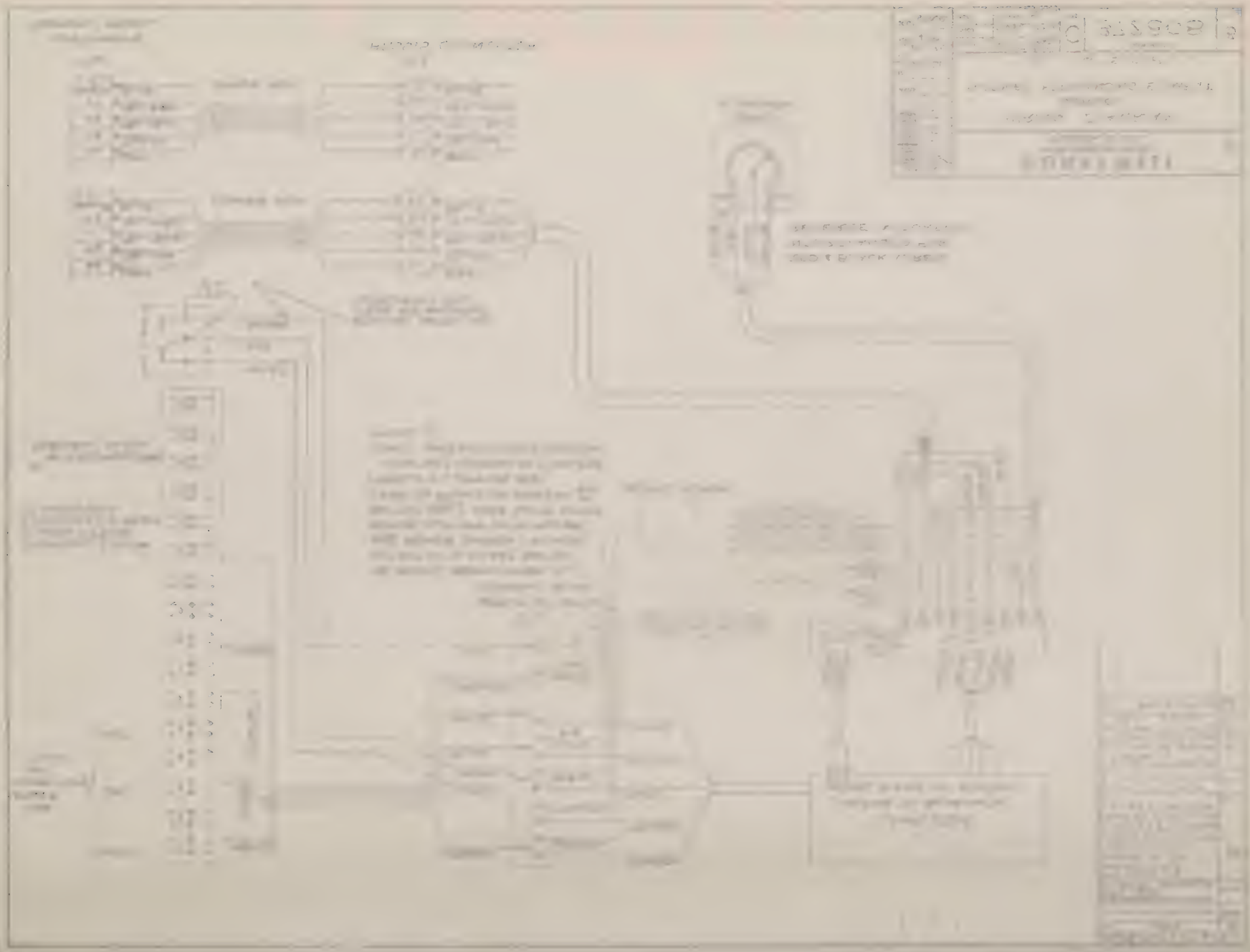
WIRING DIAGRAM
SERVO
SLIDEWIRE REBALANCING ELEMENT
CL. 16 S.C.P.

DRAWN W.C.T. 12-11-1963
ENGR. MUBE 1-27-64
SUPV. [illegible]

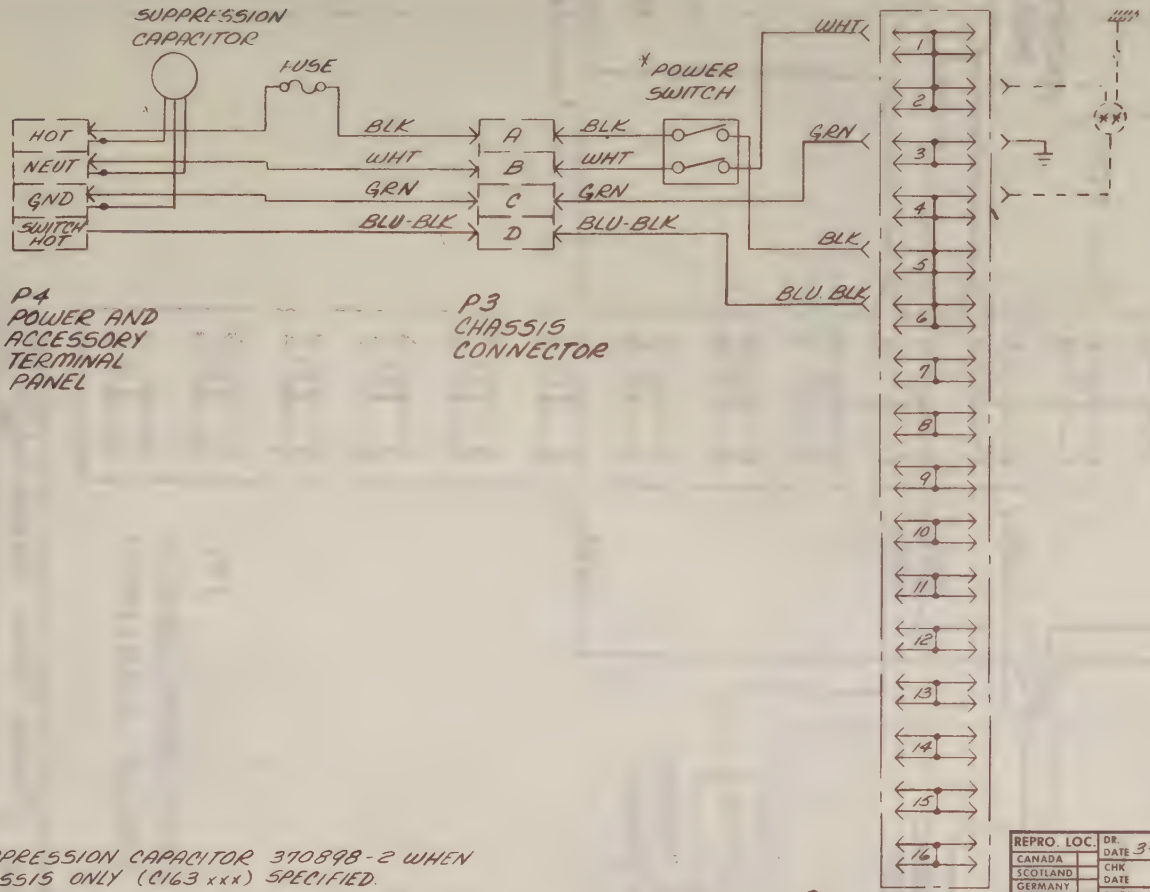
SIZE C

DRAWING NO. 372808

B



ISSUE	REVISION	APPD.
6	REDRAWN 3-1-67	



** SUPPRESSION CAPACITOR 370898-2 WHEN CHASSIS ONLY (C163 xxx) SPECIFIED.

* WITH POWER WIRING OPTION TABLE VII 152 POWER SWITCH IS OMITTED.

NOTES

REPRO. LOC.	DR. DATE 3-1-67 J
CANADA	CHK DATE
SCOTLAND	
GERMANY	ENGR. DATE
JAPAN	
FRANCE	DSGN SUPVR DATE
MEXICO	
BRAZIL	
MPLS.	
SCALE NONE	

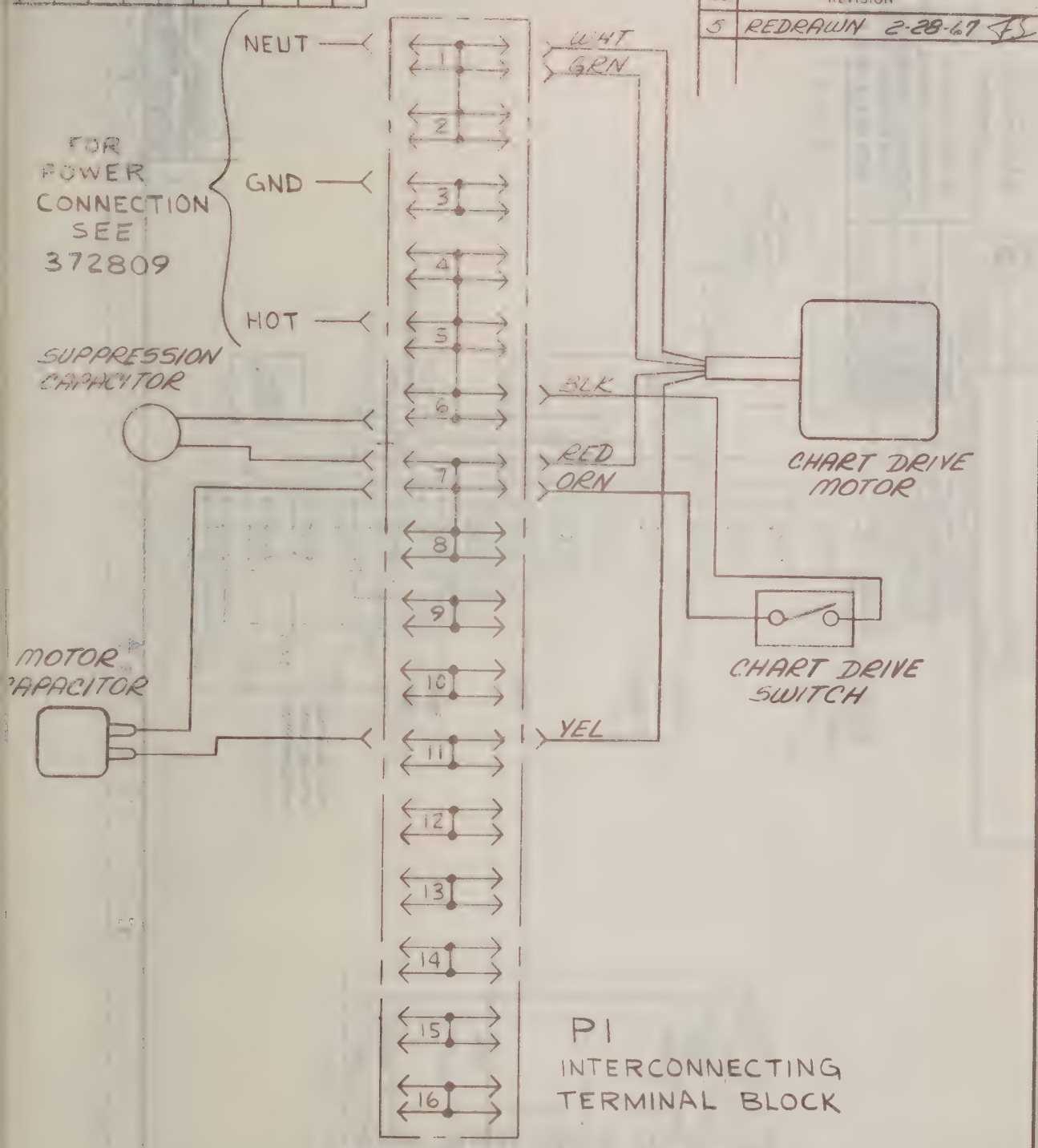
HONEYWELL INC.
FORT WASHINGTON, PA., U.S.A.

WIRING DIAGRAM
120 VOLTS POWER CONNS.
CL. 16 S.C.P.

MATERIAL	FIRST USED ON		DRAWING NO	SHEET
FINISH	REF. 7479	B SIZE	372809	OF

1	2	3	4	5	6	7	8	9	10
5	5	5	5	5					

ISS	REVISION
5	REDRAWN 2-28-67 FS



P1
INTERCONNECTING
TERMINAL BLOCK

MOTOR TURNS CLOCKWISE WHEN FACING PINION

TES:

REPRO. LOC.	
CANADA	X
SCOTLAND	
GERMANY	
JAPAN	
FRANCE	
AUSTRALIA	
BRAZIL	
USED ON	7479

HI SPEED CHART DRIVE WITH CHART DRIVE SW.
(WIRING DIAGRAM.)
CL. 16

DR	2-28-67 J	DSGN SUPVR	
CHK			
ENGR			

HONEYWELL
INC
INDUSTRIAL DIVISION

A SIZE

DRAWING NO 372814

SCALE NONE SHEET 1 OF 5

PRE REL		
ISSUE	REVISION	APPD
5	REDRAWN 3-2-67	

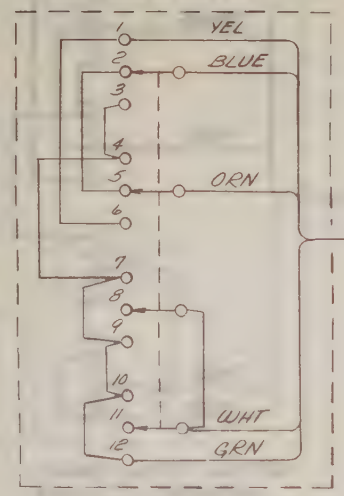


CHART DRIVE SWITCH
4 POLE 3 POSITION

FOR POWER CONNECTION SEE 372809

NEUT
GND
HOT
YEL
GRN
WHT
BLUE
ORN

MOTOR CAP

R-C SUPPRESSORS (2)

LHT
GRN
YEL

CHART DRIVE MOTOR

P1
INTERCONNECTING TERMINAL BLOCK

C.C. STATION	SPEED	SWITCH POSITION
	4	3
	OFF	2
C.C. III	CW	1
	SPEED	SWITCH POSITION

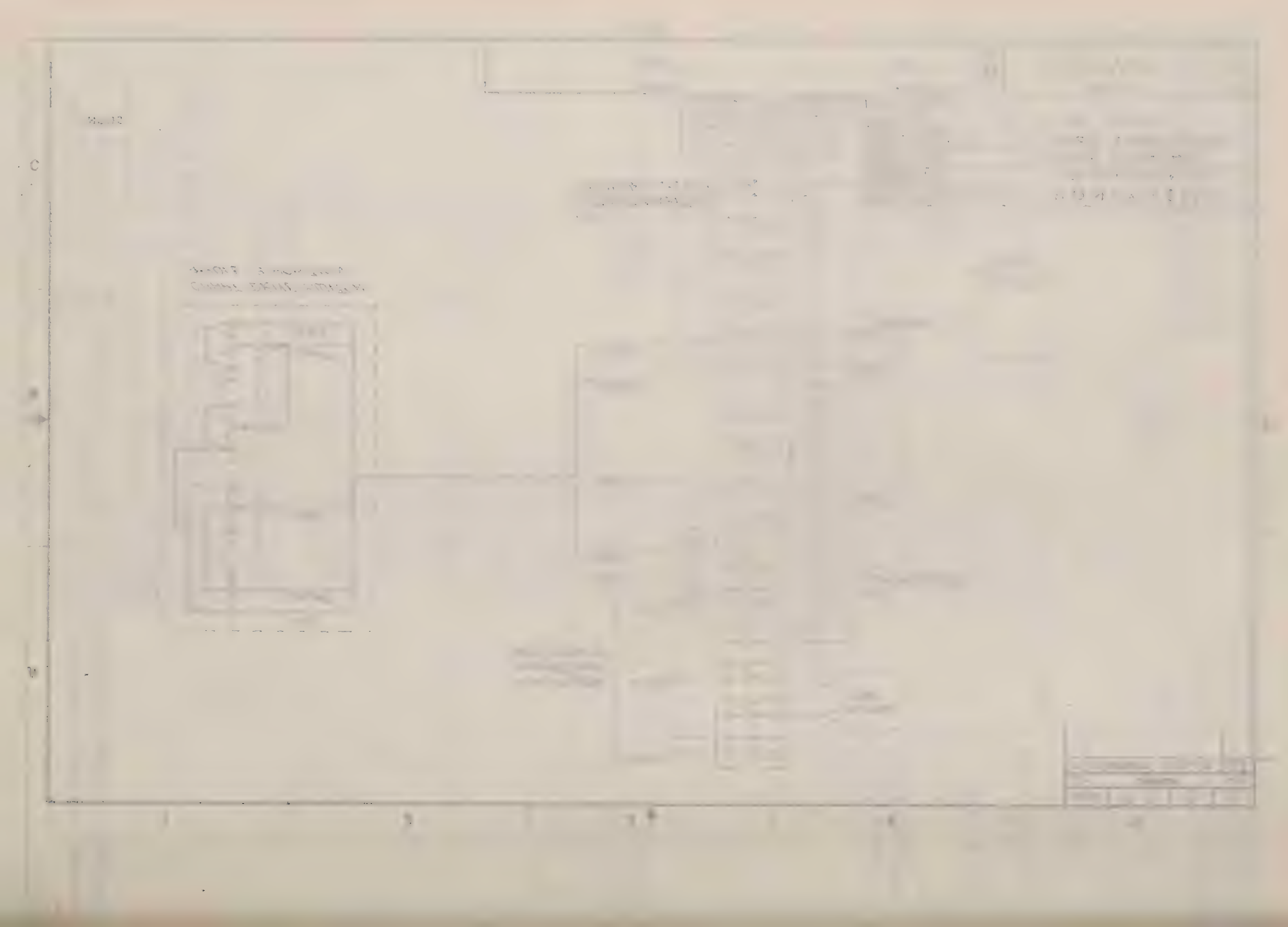
NOTES

REPRO. LOC.	DR. DATE 3-2-67 J
CANADA	CHK. DATE
SCOTLAND	
GERMANY	ENGR DATE
JAPAN	
FRANCE	DSGN. SUPVR. DATE
MEXICO	
BRAZIL	
MPLS.	
SCALE	NONE

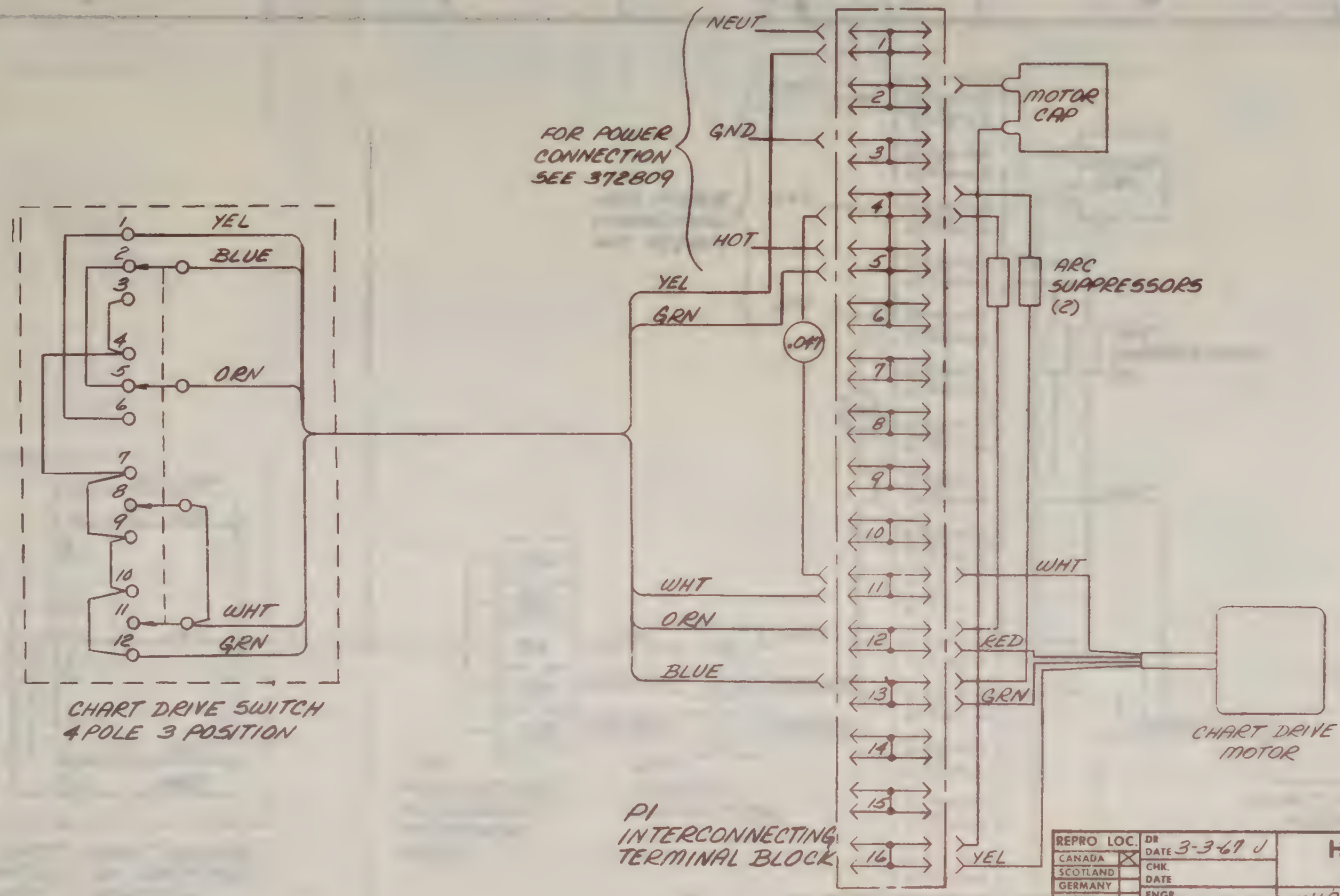
HONEYWELL INC
FORT WASHINGTON, PA., U.S.A.

WIRING DIAGRAM
2 SPEED CHART DRIVE
CL 16 S.C.P.

MATERIAL	FIRST USED ON	B SIZE	DRAWING NO 372815	SHEET OF
FINISH	REF			



PRE REL		
ISSUE	REVISION	APPD.
5	REDRAWN 3-3-67	BE



C.W.	HI	3
—	OFF	2
C.C.W	LOW	1
MOTOR ROTATION	SPEED	SWITCH POSITION

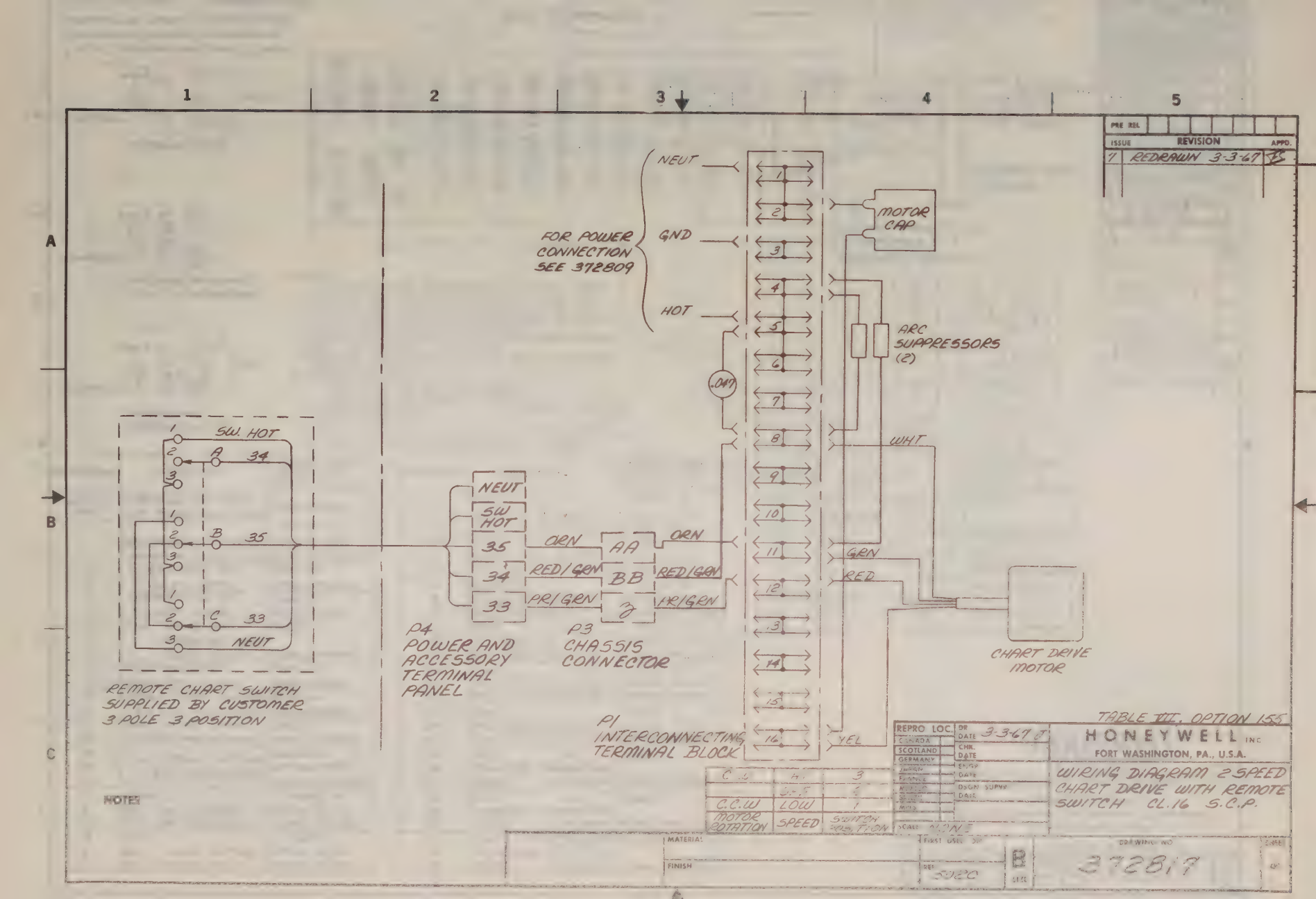
NOTES

REPRO LOC	DR DATE 3-3-67 J
CANADA	CHK. DATE
SCOTLAND	
GERMANY	ENGR. DATE
JAPAN	
FRANCE	DSGN SUPVR. DATE
MEXICO	
BRAZIL	
MPLS	
SCALE NONE	

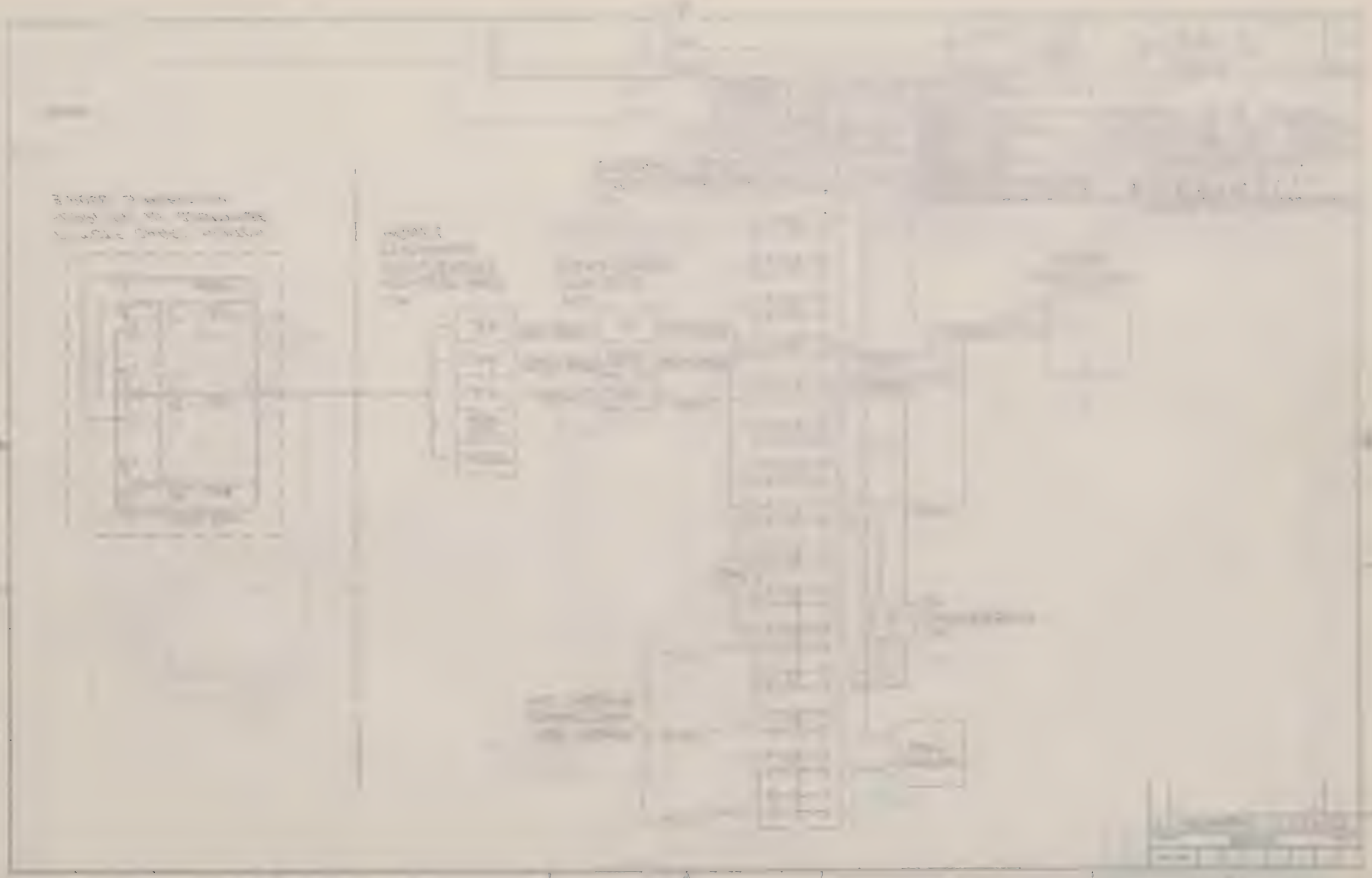
HONEYWELL INC.
FORT WASHINGTON, PA., U.S.A.

WIRING DIAGRAM
2 SPEED CHART DRIVE
SELECTOPRINT INSTRUMENTS
CLASS 16

MATERIAL	FIRST USED ON	B SIZE	DRAWING NO. 372816	SHEET OF
FINISH	REF.			

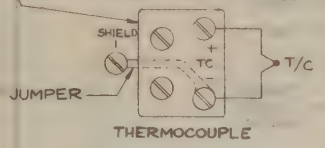

1
2
3
4
5
A
B
C
PRE REL
ISSUE
REVISION
APPD.
1 REDRAWN 3-3-67
NEUT
GND
HOT
FOR POWER CONNECTION SEE 372809
MOTOR CAP
ARC SUPPRESSORS (2)
.047
WHT
GRN
RED
YEL
CHART DRIVE MOTOR
SW. HOT
34
35
33
NEUT
REMOTE CHART SWITCH SUPPLIED BY CUSTOMER 3 POLE 3 POSITION
P4 POWER AND ACCESSORY TERMINAL PANEL
P3 CHASSIS CONNECTOR
P1 INTERCONNECTING TERMINAL BLOCK
ORN
RED/GRN
PR/GRN
AA
BB
TABLE VII, OPTION 155
C.C.W MOTOR ROTATION
LOW SPEED
SWITCH POSITION
REPRO LOC.
CANADA
SCOTLAND
GERMANY
DR DATE 3-3-67
CHK. DATE
ENGR DATE
DSGN SUPVR DATE
SCALE NONE
HONEYWELL INC
FORT WASHINGTON, PA., U.S.A.
WIRING DIAGRAM 2 SPEED CHART DRIVE WITH REMOTE SWITCH CL.16 S.C.P.
MATERIAL
FINISH
FIRST USED ON
REF 5020
B SIZE
DRAWING NO 372817
SHEET

NOTES:

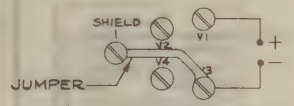


INPUT VARIABLE CONNECTIONS

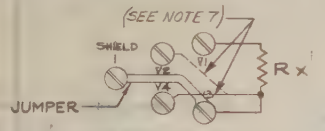
REFERENCE JUNCTION COMPENSATOR (INSTALLED ONLY ON INSTRUMENTS WITH THERMOCOUPLE PRI. ELEMENT.)



THERMOCOUPLE

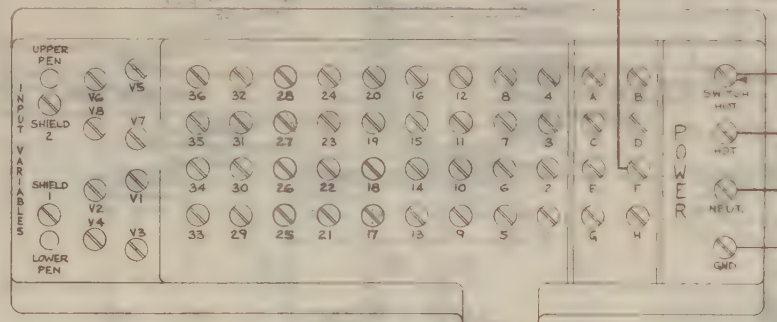


MILLIVOLT, RADIAMATIC, OR TACHOMETER



RESISTANCE THERMOMETER

REAR OF INSTRUMENT



REMOTE CHART MOTOR SWITCH (HIGH SPEED - LOW SPEED 120 V - 3A DPST SWITCH

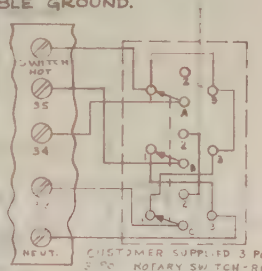
NOTE: 220-240V INSTRUMENTS DO NOT ADD ANY AUXILIARY EQUIPMENT TO THIS TERMINAL.

FUSED LINE SWITCH

GROUND SIDE OF LINE.

A.C. LINE

GROUND DIRECTLY AND SEPARATELY TO A SUITABLE GROUND.



2 SP. CHT 372617 & 689913 — CUSTOMER SUPPLIED 3 POLE 2 POS. ROTARY SW. FOR REMOTE

VIEW "A"

NOTES:-

1. INPUT VARIABLE CONNECTIONS SHOWN FOR SINGLE PEN RECORDER. FOR TWO PEN RECORDER SECOND INPUT CONNECTED TO UPPER PEN. V5, V6, V7, V8 CORRESPOND TO V1, V2, V3, V4
2. MULTIPOINT INPUTS ON 372829.
3. IN TABLES, OPTIONS USING SAME TERMINALS NOT AVAILABLE TOGETHER.
4. WIRING DIAGRAMS IN TABLE ARE INTERNAL FOR REFERENCE ONLY.
5. SWITCH CONTACTS:
   NO. – FOR PEN ABOVE SET POINT
   NC. – FOR PEN BELOW SET POINT
6. BEFORE MAKING CONNECTIONS CHECK NAMEPLATE FOR VOLTAGE RATINGS.
7. CONNECT JUMPER WIRE TO V2 FOR STANDARD SLIDEWIRE REBALANCING ELEMENT ONLY. CONNECT JUMPER WIRE TO V4 FOR SLIDE WIRE REBALANCING ELEMENT.

DESIGNATION	FUNCTION	MODEL SPEC. OPTION No WIRING DIAG. No.
SWITCH HOT	NORMALLY HOT WHEN INST. POWER SWITCH ON	STANDARD
F	REMOTE CHART SWITCH FOR LOW OR HIGH SPEED CH. DR.	TABLE VII OPTION 155 W/DIAG 372813 & 372814
A	OPERATION PEN	TABLE VII
B	RIGHT HAND	W/DIAG. 372822
C	OPERATION PEN	TABLE VII
D	LEFT HAND	W/DIAG. 372822
C	(COM) THREE WAY	TABLE VII
D	OPERATION PEN	
E	LEFT HAND	W/DIAG. 372822
G	PRINT HOLDOUT	TABLE VII
H	(MULTIPOINT ONLY)	W/DIAG. 372825
G	PEN LIFTER LOWER	TABLE VII
H	(PEN RECORDING ONLY)	W/DIAG. 372825
4	PEN LIFTER UPPER	TABLE VII
8	(PEN RECORDING ONLY)	W/DIAG. 372825
33	TWO SPEED CHART DRIVE	TABLE VII
34	REMOTE SWITCHING	OPTION 155
35		W/DIAG 372617 & 689913
1	(COM.)	TABLE IV
2	(N.C.) No. 1 SWITCH	OPTION 01XXX
3	(N.O.) NON-SELECTIVE	W./DIAG. 372156
5	(COM.)	TABLE IV
6	(N.C.) No. 2 SWITCH	OPTION 01XXX
7	(N.O.) NON-SELECTIVE	W./DIAG. 372156

DESIGNATION	FUNCTION	MODEL SPEC. OPTION No WIRING DIAG. No.
9	(COM.)	TABLE IV
10	(N.C.) No. 3 SWITCH	OPTION 01XXX
11	(N.O.) NON-SELECTIVE	W./DIAG. 372156
13	(COM.)	TABLE IV
14	(N.C.) No. 4 SWITCH	OPTION 01XXX
15	(N.O.) NON-SELECTIVE	W./DIAG. 372156
17	(COM.)	TABLE IV
18	(N.C.) NO. 5 SWITCH OR 1ST SWITCH ON UP PEN	OPTION 01XXX
19	(N.O.) NON-SELECTIVE	W./DIAG 372156
21	(COM.)	TABLE IV
22	(N.C.) NO. 6 SWITCH OR 2ND SWITCH ON UP PEN	OPTION 01XXX
23	(N.O.) NON-SELECTIVE	W./DIAG. 372156
25	(COM.)	TABLE IV
26	(N.C.) NO. 7 SWITCH OR 3RD SWITCH ON UP PEN	OPTION 01XXX
27	(N.O.) NON-SELECTIVE	W./DIAG. 372156
29	(COM.)	TABLE IV
30	(N.C.) NO. 8 SWITCH OR 4TH SWITCH ON UP PEN	OPTION 01XXX
31	(N.O.) NON SELECTIVE	W./DIAG. 372156
12	(0%) 1ST.	TABLE VII
16	(COLLECTOR) TRANSMITTING	
20	(100%) SLIDEWIRE	W/DIAG 374838
24	(0%) 2ND.	TABLE VII
28	(COLLECTOR) TRANSMITTING	
32	(100%) SLIDEWIRE	W./DIAG 374838
13	(0%) RE TRANSMITTING SLIDEWIRE CIRCUIT THRU	TABLE VII
14	(COLLECTOR) TRANSMITTING P/W	
15	(100%) ON UP PEN	W./DIAG. 374838

DESIGNATION	FUNCTION		MODEL SPEC. OPTION No. WIRING DIAG. No.
25	(0%) 4TH TRANSMITTING SLIDEWIRE		TABLE VII
26	(COLLECTOR) 2ND TRANSMITTING P/W		
27	(100%) ON UP PEN		W/DIAG. 374838
33	SET POINT Ⓐ		APPLIES IV
34	PEN POSITION Ⓐ	REMOTE PROP. CONTROL	OPTION 03XX, 06XX, 07XX & 08XX
35	0%		W/D 374838
36	100%		
33	ERROR	REMOTE PROP. CONTROL	TABLE IV
35	0%		OPTIONS 04XX OR
36	100%		05XX W/D 374838

6	ADDED NOTE #6 6-30-65	D.C.
7	374838 WAS 372156 (a) 7-12-65	D.C.
8	ADDED NOTE AT A & REF'S.	
9	REVISED VIEW A 5-16-66	
10	ADDED NOTE 7 TO DRAWING & REF'S. 6-7-66	
11	@ C-6 & E-2 CHGD. TO G89913, E-5 DELETE LAB RECORDER. 9-14-66	
12	REV'D 9-18-67	
13	Ⓐ REVISED 3-20-68	

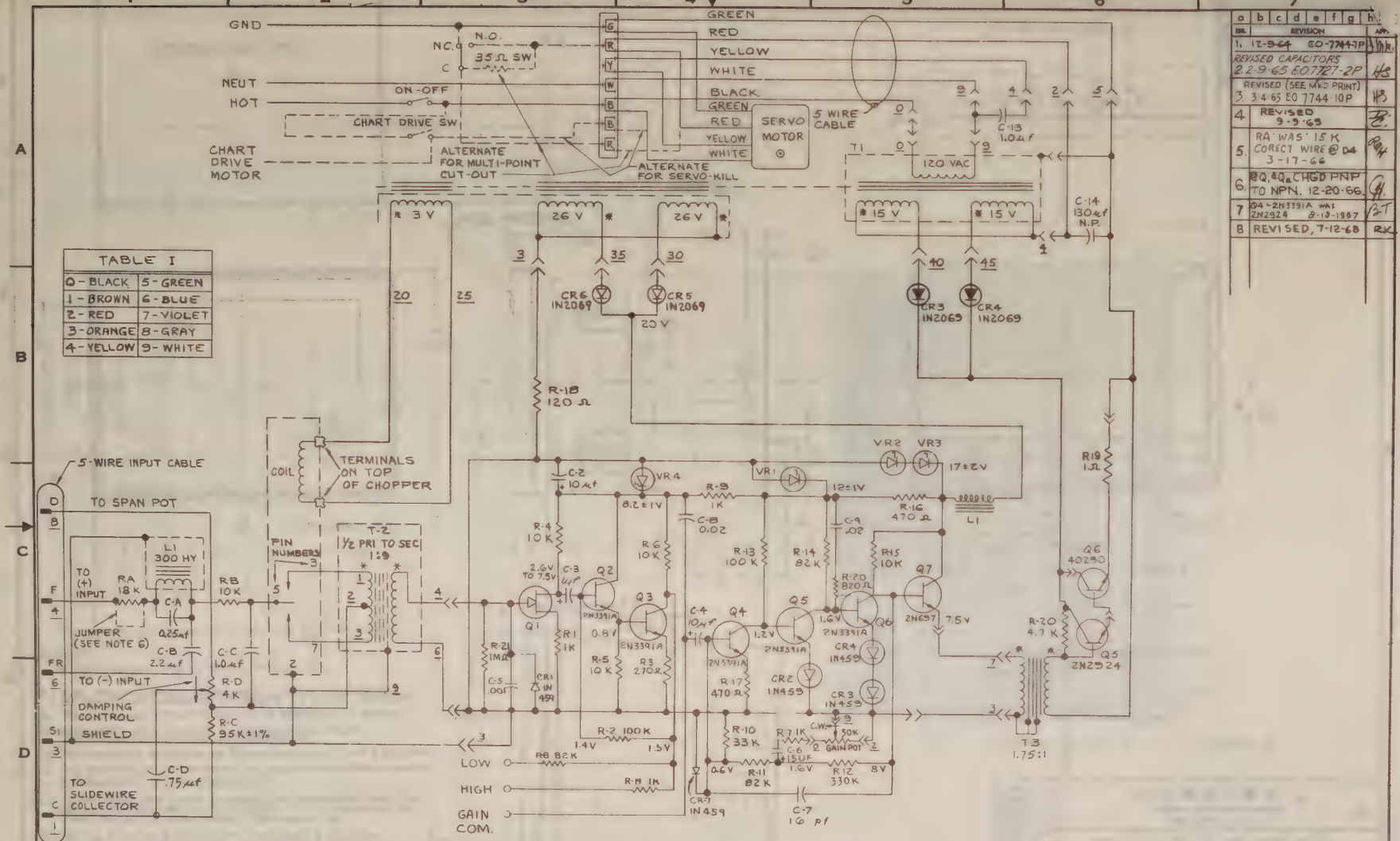
REPRO LOC	
TORONTO	
NEWHSE.	
WHSE.	
GERMANY	
TOKYO	
AMIENS	
AUSTRALIA	
MATLS	
IE	JS 1-23
CHK.	LM 1-22
JOB	7479
SCALE	3/4 SIZE

HONEYWELL
BROWN INSTRUMENTS DIVISION
PHILADELPHIA, PA., U.S.A.

WIRING DIAGRAM
(EXTERNAL)
CUSTOMER TERMINAL PANEL CONNECTIONS
CL 16 S.C.P.

DRAWN	TRIMBORN	12-31-1962	
ENGR	MUSE 1-23		
SUPV	J. PETRONELLA 1-24-63		

DRAWING NO. C 372827 3 CL



	REVISION			APP.
1.	12-9-64	EO-7744-1P		
	REVISED CAPACITORS 2.2.9.65 EO7727-2P			HS
	REVISED (SEE MKD PRINT)			
3.	3.4.65	EO 7744-1OP		HS
4.	REVISED 9-9-65			
5.	RA WAS 15 K CORECT WIRE @ D4 3-17-66			
6.	Q1, Q2 CHGD PNP TO NPN. 12-20-66.			
7	Q4-2N3391A WAS 2N2924 8-10-1967			
8	REVISED, 7-12-68			

NOTES

1. - D.C. VOLTAGE READ 20,000 OHM / VOLT METER
2. - * DENOTES THE SAME INSTANTANEOUS POLARITY.
3. - UNDERLINED NUMBERS DENOTE WIRE COLORS PER TABLE I
4. - REFERENCE ASS'YS.: 374578
5. - REFERENCE SCHEMATICS & WIRING DIAGRAMS: 372808
6. - JUMPER ADDED WHEN INSTRUMENT IS TO BE USED WITH A.R.U.

REPRO. LOC.	
TORONTO	✓
NEWTOWN	
[illegible]	
GERMANY	
TOKYO	
AMSTERDAM	
AUSTRALIA	
MATL.	
CHK.	
JOB	7744
SCALE	CHL

TOLERANCE UNLESS NOTED: One Place (.X) ±.020; Two Place (.XX) ±.015; Three Place (.XXX) ±.005; Angular ±1°

USED ON

DES.

FIN.

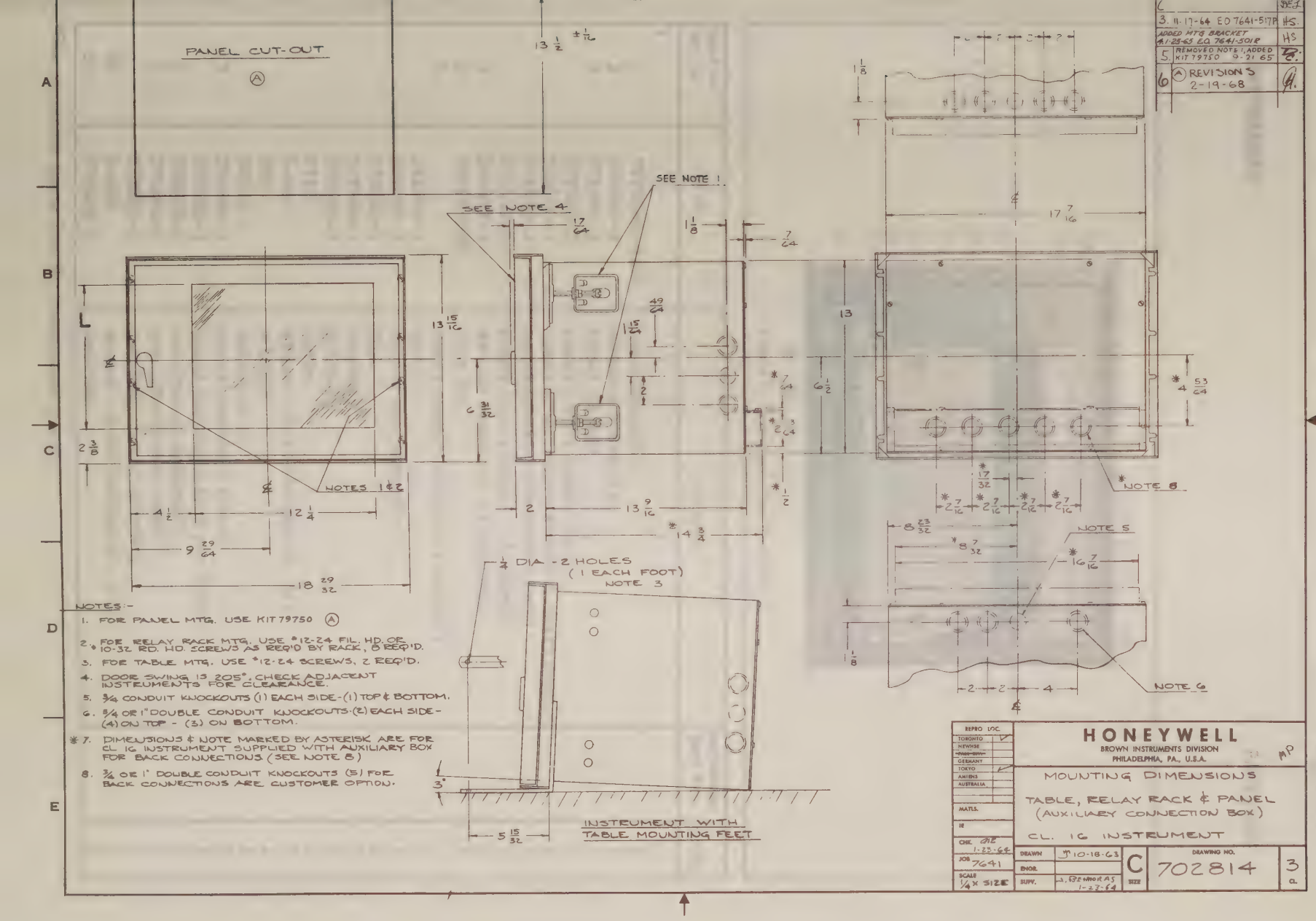
MATL.

HONEYWELL
BROWN INSTRUMENTS DIVISION
PHILADELPHIA, PA., U.S.A.

SCHEMATIC
SERVO AMPL
SINGLE OUTPUT (SLIDEWIRE)
CL. 16 INSTRUMENT

DRAWN	JO	11-64
ENGR.		
SUPV.		

SIZE C — DRAWING NO. 374599 — 3



3.	11-17-64 E.O. 7641-517	HS.
	ADDED MTG BRACKET #1-25-63 E.O. 7641-5018	HS
5.	REMOVED NOTE 1, ADDED KIT 79750 9-21-65	
6	Ⓐ REVISIONS 2-19-68	

NOTES:-

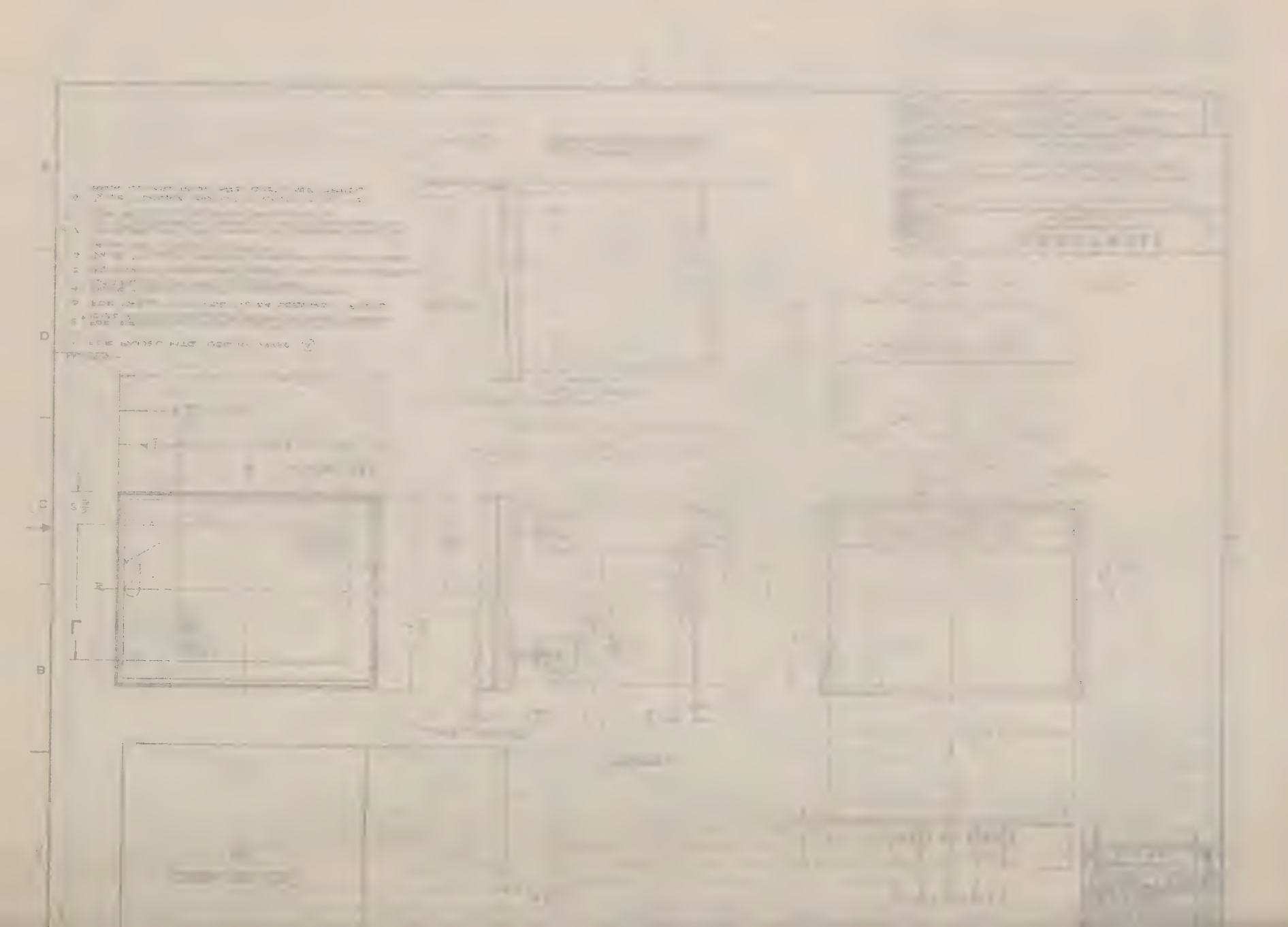
1. FOR PANEL MTG. USE KIT 79750 Ⓐ
2. FOR RELAY RACK MTG. USE #12-24 FIL. HD. OR 10-32 RD. HD. SCREWS AS REQ'D BY RACK, 8 REQ'D.
3. FOR TABLE MTG. USE #12-24 SCREWS, 2 REQ'D.
4. DOOR SWING IS 205°. CHECK ADJACENT INSTRUMENTS FOR CLEARANCE.
5. ¾ CONDUIT KNOCKOUTS (1) EACH SIDE-(1) TOP & BOTTOM.
6. ¾ OR 1" DOUBLE CONDUIT KNOCKOUTS-(2) EACH SIDE-(4) ON TOP - (3) ON BOTTOM.
7. * DIMENSIONS & NOTE MARKED BY ASTERISK ARE FOR CL 16 INSTRUMENT SUPPLIED WITH AUXILIARY BOX FOR BACK CONNECTIONS (SEE NOTE 8)
8. ¾ OR 1" DOUBLE CONDUIT KNOCKOUTS (5) FOR BACK CONNECTIONS ARE CUSTOMER OPTION.

REPRO LOC.
TORONTO ✓
NEWHSE
GERMANY
TOKYO ✓
AMIENS
AUSTRALIA
MATLS.
IE
CHK. DHZ 1-25-64
JOB 7641
SCALE ¼ x SIZE

HONEYWELL
BROWN INSTRUMENTS DIVISION
PHILADELPHIA, PA., U.S.A.

MOUNTING DIMENSIONS
TABLE, RELAY RACK & PANEL
(AUXILIARY CONNECTION BOX)
CL. 16 INSTRUMENT

DRAWN J.P. 10-18-63
ENGR.
SUPV. J. Gilmore AS 1-27-64
C SIZE
DRAWING NO. 702814
3 a.



INSTRUMENT

PARTS LIST

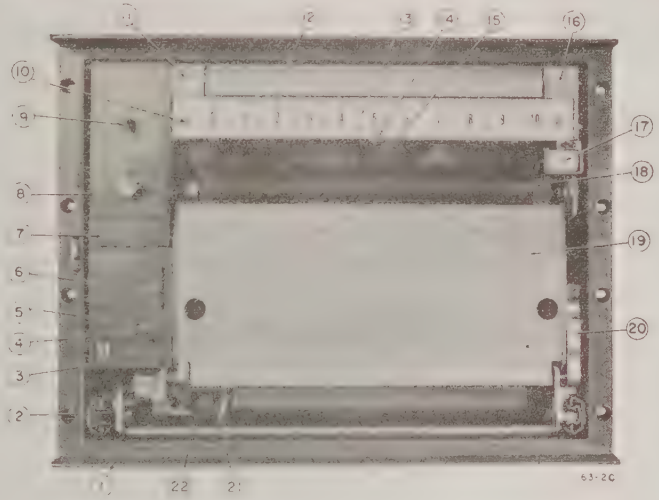


Figure 1. Instrument Door Removed

Figure and Key No.	Part No	Description	Recommended Spare Parts	Quantity
1				
1	*370684-item	case assembly		1
2	370530-1	chassis assembly		1
3	372590-1	panel (blank)		1
	372590-2	panel (chart supply only)		1
	372590-3	panel (chart drive switch & chart supply)		1
	372590-4	panel (chart drive switch only)		1
	372590-5	panel (chart supply - 4 speed)		1
4	370897-1	switch assembly - (optional)		1
5	79075-000	ring nut		1
6		chart supply indicator (optional)		
	372598-1	shaft		1
	372597-1	arm & hub assembly		1
	372599-1	link		1
	372594-1	bushing		1
	372593-1	pointer		1
	9748	cotter		1
	5-808	screw - 8-32 binding hd. 1/2"		1
	299	washer		1
	40958-1	setscrew		1
7	370586-1	panel assembly (blank)		1
	370586-4	panel assembly (one pen lifter)		1
8	370639-1	ink drawer assembly		1
9	372202-1	pen lifter lever (red)		1
	372202-2	pen lifter lever (purple)		1
10	5-403	screw - 4-40 binding hd. 3/16"		2
11	370502-1	bracket		1

*See separate parts list for component parts.

Figure and Key No	Part No	Description	Recommended Spare Parts	Quantity
12	370516-1	cover (with lighting - 2 pen - optional)		1
	370516-2	cover (with lighting - 1 pen & multi-point - optional)		1
13	45-range	scale (specify range)		1
14	*370638-1	pen carriage assembly		1
15	370553-1	pen assembly	X	1
16	370502-2	bracket		1
17	*370300-item	operation pen (optional)		1
18	370359-1	chart drum assembly		1
19	*370400-1	chart module assembly		1
20	370394-1	handle assembly		1
21	370626-2	nameplate (power)		1
22	370877-1	switch assembly (power - optional)		1

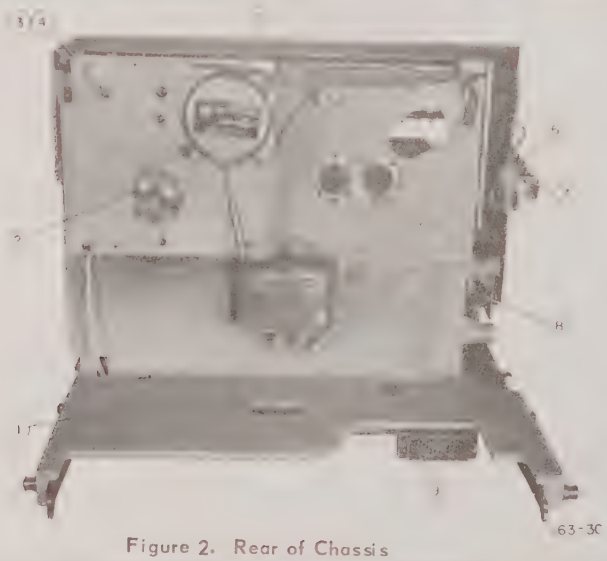


Figure 2. Rear of Chassis

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
2				
1	370530-1	chassis assembly		1
2	*372398-1	servo drive assembly (.2 sec)		1
	*370266-1	servo drive assembly (1/2 & 1 sec.)		1
	*370250-1	servo drive assembly (3,5 & 15 sec.)		1
3	8-805	screw - 8-32 fillister hd. 5/16"		6
4	76091	washer		6
5	687610-502	servo motor (.2 sec.)	X	1
	*365755-503	servo motor (1 sec.)	X	1
	365755-504	servo motor (1/2 sec.)	X	1

INSTRUMENT **PARTS LIST**

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
	*365754-510	servo motor (3, 5 & 15 sec.)	X	1
	365754-511	servo motor (5 & 15 sec.)	X	1
6	365524	ink bottle (operation pen)		1
7	370337-1	bracket		1
8	(see table)	chart drive motor	X	1
9	370866-1	connector		1

CHART DRIVE MOTOR		
120V 60 Cycle	R.P.M.	120V 50 Cycle
370498-1	1/40	370499-1
-2	1/20	-2
-3	3/20	-3
-4	1/4	-4
-5	3/10	-5
-6	1/2	-6
-7	3/4	-7
-8	1-1/2	-8

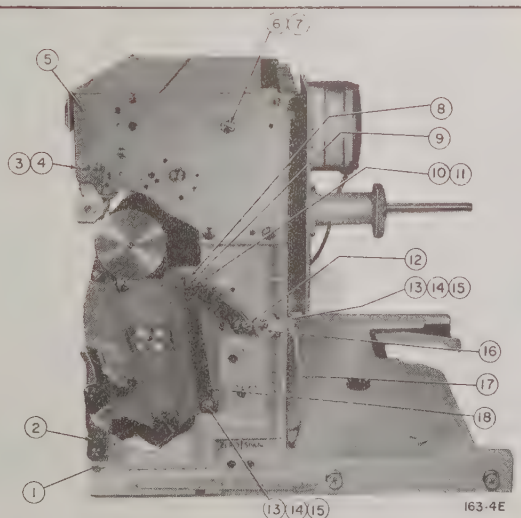


Figure 3. Right side of Chassis

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
3				
1	370530-1	chassis assembly		1
2	370394-1	handle assembly		1
3	5-603	screw - 6-32 binding hd. 3/16"		2
4	78196	lockwasher		2
5	370562-1	plate		1
6	8-805	screw - 8-32 fillister hd. 5/16"		3
7	76091	washer		3
8	370398-2	stop link		1
9	370484-1	stud		1
10	9748	cotter		1
11	4971	washer		1
12	370486-1	spring		1
13	5-806	screw - 8-32 binding hd. 3/8"		2
14	299	washer		2
15	370399-1	spacer		2
16	370835-1	screw (amplifier mount)		1
17	370882-1	connector assembly		1
18	370398-1	stop link		1

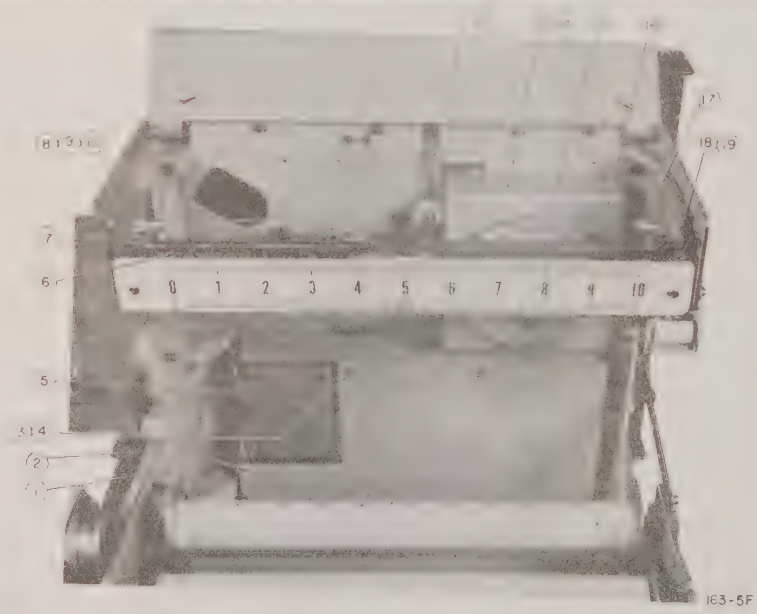


Figure 4. Components – Front of Chassis

INSTRUMENT **PARTS LIST**

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
4				
1	370530-1	chassis assembly		1
2	370744-1	cover		1
	370744-2	cover (used with checking terminal option)		1
3	372919-1	screw		2
4	78196	washer		2
5	*370698-item	amplifier assembly	X	1
6	370582-1	tubing	X	1
7	370574-1	shaft		1
8	370558-2	pulley & bracket ass'y.		1
9	8-803	screw - 8-32 fillister hd. 3/16"		2
10	76091	washer		2
11	370887-1	terminal block ass'y.		1
12	370856-1	cover (terminal panel)		1
13	*370801-item	service replacement slidewire ass'y.	X	1
14	370816-1	cover for slidewire		1
15	370804-2	pulley assembly		1
16	370292-1	drive cable	X	1
17	370558-1	pulley & bracket ass'y.		1
18	350962-4	cable clamp		1
19	5-804	screw - 8-32 binding hd. 1/4"		1

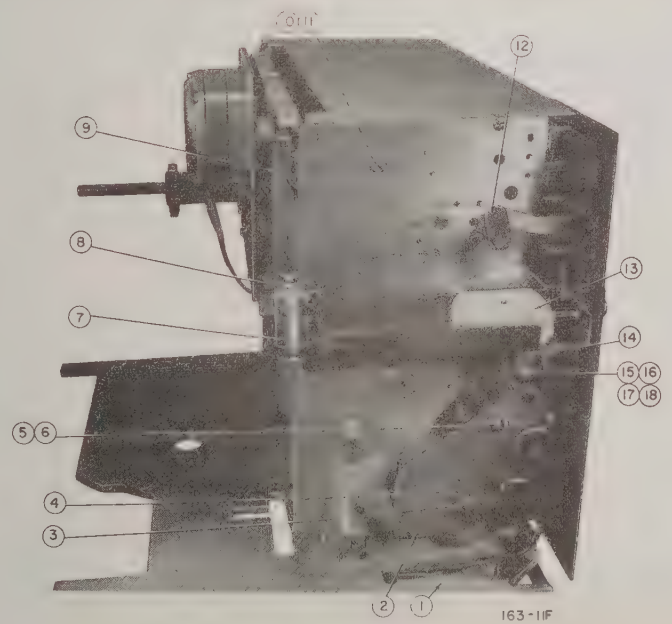


Figure 5. Left side of Chassis

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
5				
1	370530-1	chassis assembly		1
2	*370380-1	chart drive assembly (low speed)		1
3	723246-1	knob		2
4	370110-1	change gear (40T - optional)		1
5	5-832	screw - 8-32 binding hd. 2"		3
6	9771	lockwasher		3
7	370639-1	ink drawer assembly		1
8	370582-1	tubing	X	1
9	370563-1	plate		1
10	5-805	screw - 8-32 binding hd. 5/16"		3
11	9771	lockwasher		3
12	372207-1	hub assembly		1
13	370621-1	bottle assembly		1
14	370604-1	brace plate		1
15	5-603	screw - 6-32 binding hd. 3/16"		1
16	78196	lockwasher		1
17	370603-1	stud brace		1
18	299	washer		1

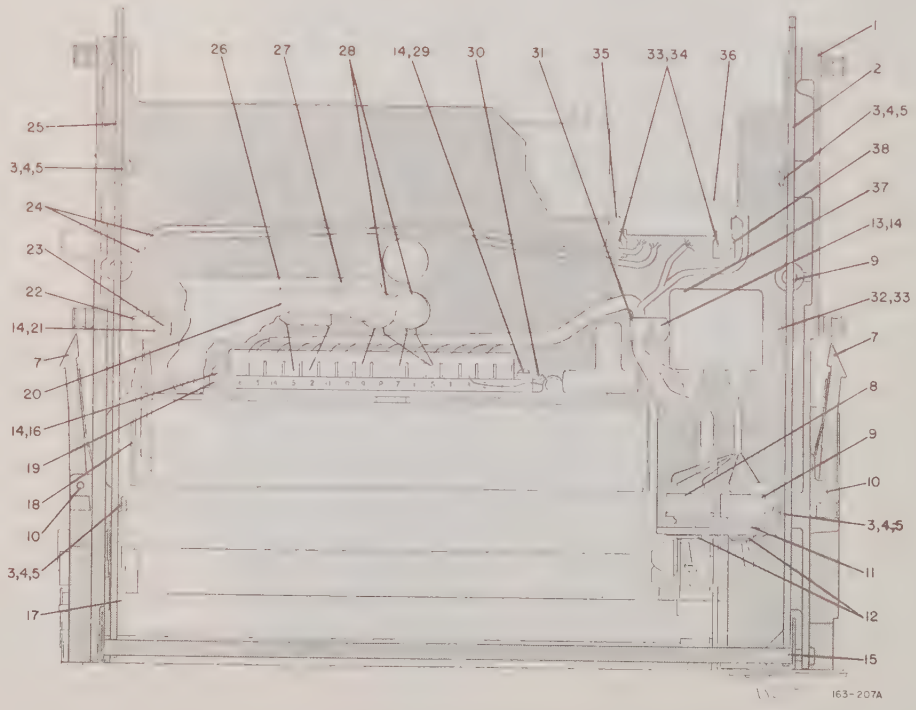


Figure 6. Bottom of Chassis

INSTRUMENT **PARTS LIST**

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
6				
1	370530-1	chassis assembly		1
2	370507-1	latch assembly		1
3	5-807	screw - 8-32 binding hd. 7/16"		4
4	917	washer		5
5	370514-1	bushing		4
6	370515-1	spring		2
7	723738-1	catch & spring ass'y.		2
8	370877-1	switch ass'y. (power)		1
9	370624-1	switch ass'y. (light)		1
10	370510-1	pin		2
11	77310	nut		2
12	79075-000	ring nut		2
13	8-805	screw - 8-32 fillister hd. 5/16"		1
14	364998	washer		4
15	370503-1	handle assembly		1
16	8-806	screw - 8-32 fillister hd. - 3/8"		1
17	*370400-1	chart module assembly		1
18	*370697-item	servo circuit unit (one pen & multi-point)		1
		servo circuit unit (two pen)		2
19	370885-1	terminal block assembly		1
20	370844-1	R-C unit assembly		1
21	4908	nut		1
22	350962-1	cable clamp		1
23	5-812	screw - 8-32 binding hd. - 3/4"		1
24	370882-1	connector assembly (one pen, two pen & multi-point)		1
	370882-2	connector assembly (two pen)		1
25	370502-2	latch assembly		1
26	370870-1	cover		1
27	5-804	screw - 8-32 binding hd. - 1/4"		3
28	370898-1	capacitor assembly		2
29	5-807	screw - 8-32 binding hd. - 7/16"		1
30	370847-1	wire assembly (ground)		1
31	350962-3	cable clamp		1
32	8-803	screw - 8-32 fillister hd. - 3/16"		1
33	76091	lockwasher		3
34	8-804	screw - 8-32 fillister hd. - 1/4"		2
35	8-404	screw - 4-40 fillister hd. - 1/4"		2
36	370866-1	connector (56 pts.)		1
37	370846-1	capacitor assembly		1
38	370857-1	bracket		2

CASE ASSEMBLY (SINGLE AND 2 PEN)

PARTS LIST

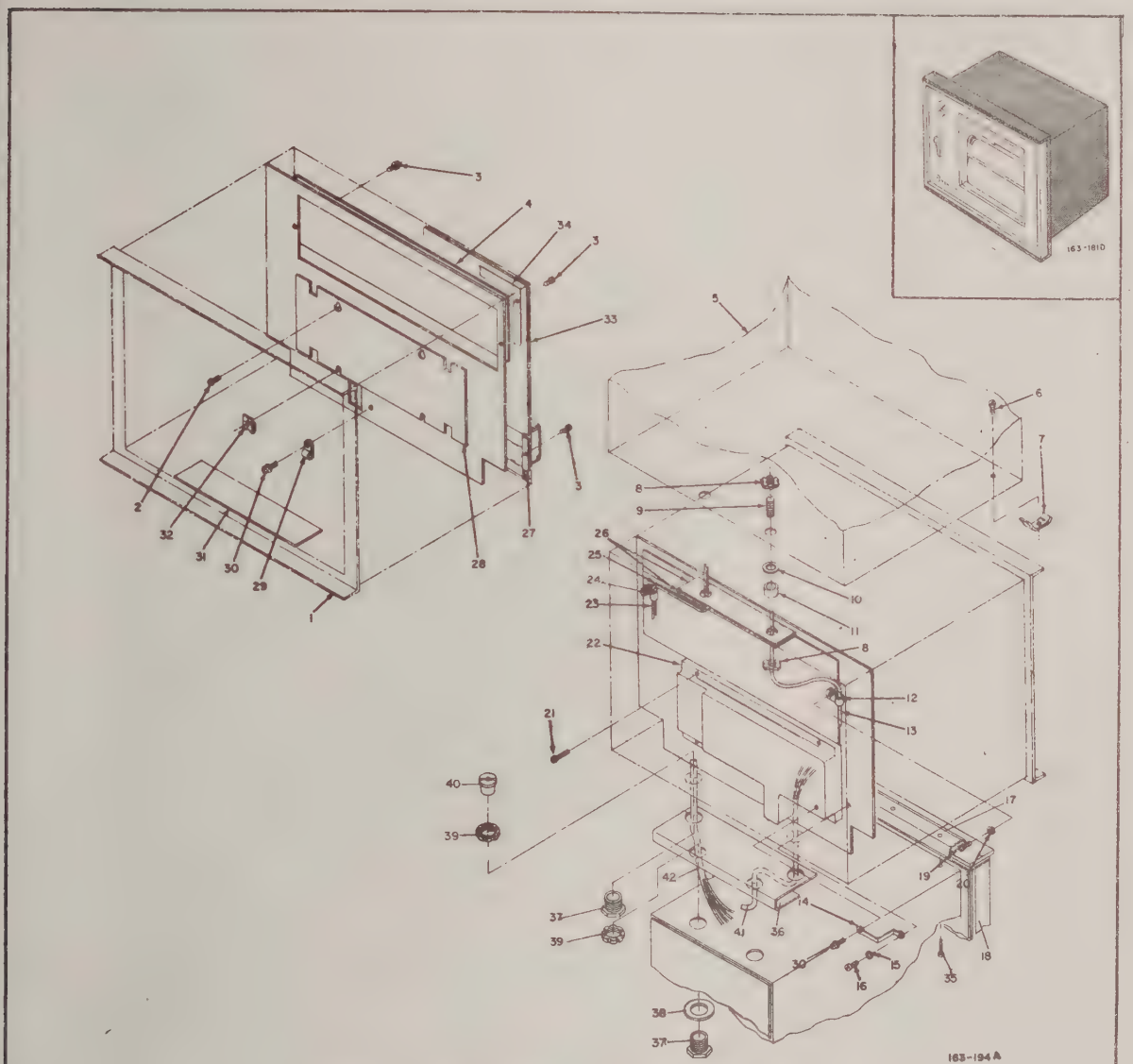


Figure 1. Case Assembly – Single Point and 2 Pen

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1	370684-item	case assembly (see figure 2)		1
2	5-605	screw - 6-32 binding hd. 5/16"		4
3	370671-1	screw		A.R.
4	370665-1	plate - cover (color - dark beige)		1
	370665-2	plate - cover (specify color)		1
5	*687371-1	A.R.U. case single channel		1
	*687318-1	A.R.U. case double channel		1
6	11-010	screw - 10-32 hex. hd. 5/8"		4
7	372407-1	clamp		4
8	5262-1	lock nut (conduit)		6

*See separate component parts list section.

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
9	5416-5	nipple (close)		3
10	6471	washer		3
11	372405-1	spacer		3
12	350962-1	cable clamp		2
13	372409-1	power cable		1
14	370883-1	strap - ground		1
15	299	washer		1
16	359839-1	screw		1
17	374833-001	clamp		1
18	*371220-Item	proportional controller		1
19	359838-5	screw		2
20	4972	washer		2
21	8-610	screw - 6-32 fillister hd. 5/8"		4
22	*370868-item	terminal panel ass'y.		1
23	372410-2	input cable (double channel)		1
24	350962-2	cable clamp		1
25	372410-1	input cable (single channel)		1
26	372406-1	adapter plate		2
27	372402-1	auxiliary box (color dark beige with knockouts - optional)		1
	372402-2	auxiliary box (color dark beige w/o knockouts - optional)		1
	372402-3	auxiliary box (specify color with knockouts - optional)		1
	372402-4	auxiliary box (specify color w/o knockouts - optional)		1
28	370869-1	cover		1
29	350962-2	cable clamp		1
30	9-804	screw - 8-32 washer hd. 1/4"		1
31	370521-1	nameplate		1
32	724467-2	speed nut		4
33	372403-1	cover plate (color dark beige - optional)		1
	372403-2	cover plate (specify color - optional)		1
34	372417-1	gasket (top and bottom - optional)		2
	372417-2	gasket (sides - optional)		2
35	11-014	screw - 10-32 hex hd. 7/8"		3
36	374834-001	bracket, adapter		1
37	365440	nipple, chase		2
38	77214 wa	washer		2
39	5262-2	locknut, conduit 3/4"		4
40	41343	bushing, insulating		4
41	371291-1	cable, 3 wire		1
42	371290-1	cable, 4 wire		1

CASE ASSEMBLY

PARTS LIST

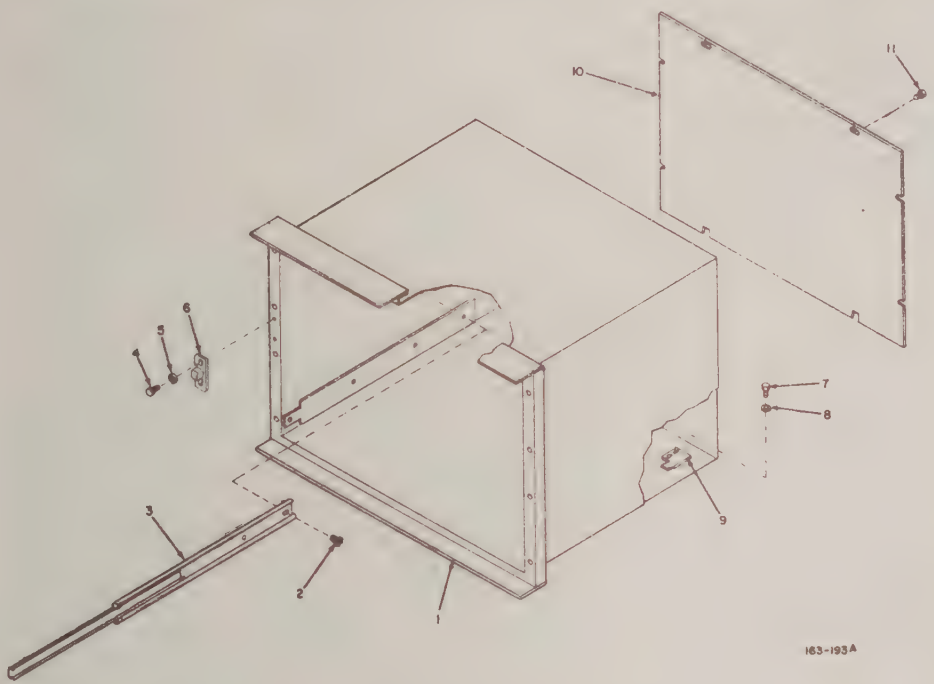


Figure 2. Figure 2. Case Assembly

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
2				
	370684-1	case assembly (color - dark beige)		1
	370684-2	case assembly (specify color)		1
1	370681-1	case (color - dark beige)		1
	370681-2	case (specify color)		1
2	370653-1	screw		8
3	370675-1	slide - chassis		2
4	5-603	screw - 6-32 binding hd. 3/16"		2
5	78196	lockwasher		2
6	370661-1	retainer - latch		1
7	5-803	screw - 8-32 binding hd. 3/16"		4
8	9771	lockwasher		4
9	370664-1	plate - chassis stop (r.h.)		1
	370664-2	plate - chassis stop (l.h.)		
10	370654-1	plate - case back (color - dark beige		1
	370654-2	plate - case back (specify color)		1
11	370671-1	screw - self tapping		6

DOOR ASSEMBLY

PARTS LIST

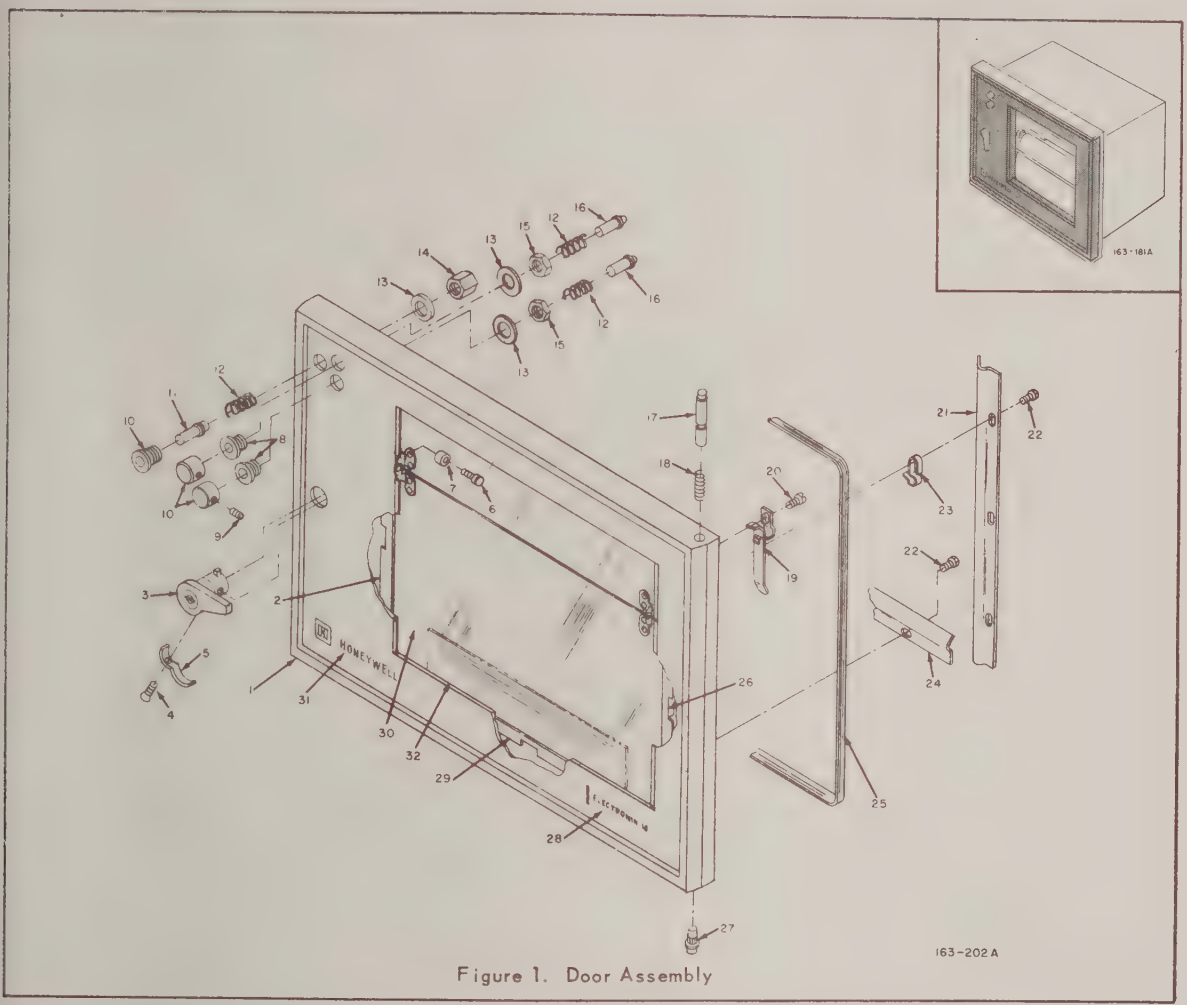


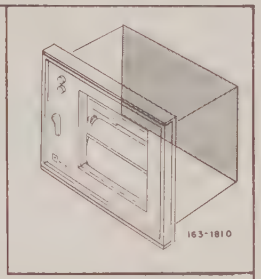
Figure 1. Door Assembly

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1		door assembly - specify model and serial number of instrument		
1	370651-1	door (multipoint or 1 pen - color dark beige)		1
	370651-2	door (multipoint or 1 pen - specify color)		1
	370651-3	door (2-pen - color dark beige)		1
	370651-4	door (2-pen - specify color)		1
2	370691-2	gasket		1
3	370689-1	latch with lock (optional - color dark beige)		1
	370689-2	latch with lock (optional - specify color)		1

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
	370690-1	latch without lock (color dark beige)		1
	370690-2	latch without lock (specify color)		1
4	7-203	screw - 2-56 flat hd. 3/16"		1
5	370692-1	clip - spring		1
6	8-205	screw - 2-56 fillister hd. 5/16"		1
7	370688-1	stop		1
8	370678-1	knob		2
9	40958-2	setscrew		2
10	370679-1	bushing		3
11	372884-1	plunger		1
12	74253	spring		3
13	370680-1	washer		3
14	372883-1	housing		1
15	370677-1	nut		2
16	74257-3	shaft		2
17	370668-1	pin - door		1
18	79034	spring		1
19	370655-1	lever ass'y.		
20	5-604	screw - 6-32 binding hd. 1/4"		1
21	370662-1	strip - retaining		3
22	24-804	screw - 8-32 hex hd. 1/4"		9
23	372983-1	clip r.h. (used on split glass option)		1
	372983-2	clip l.h. (used on split glass option)		1
24	372995-1	strip - retaining (used on split glass option)		1
25	370667-1	gasket		1
26	370691-1	gasket		1
27	723693-2	pin - door		1
28	370659-1	decal comania		1
29	370691-3	gasket		1
30	370670-1	glass (double thick - optional)		1
	370670-2	glass (plexi-glass-optional)		1
	370670-3	glass (safety-glass-optional)		1
	372991-1	glass ass'y. (split-glass door - optional)		1
31	370658-1	decal comania		1
32	370663-1	auxiliary nameplate (optional - specify exact wording)		1

TERMINAL PANEL ASSEMBLY

PARTS LIST



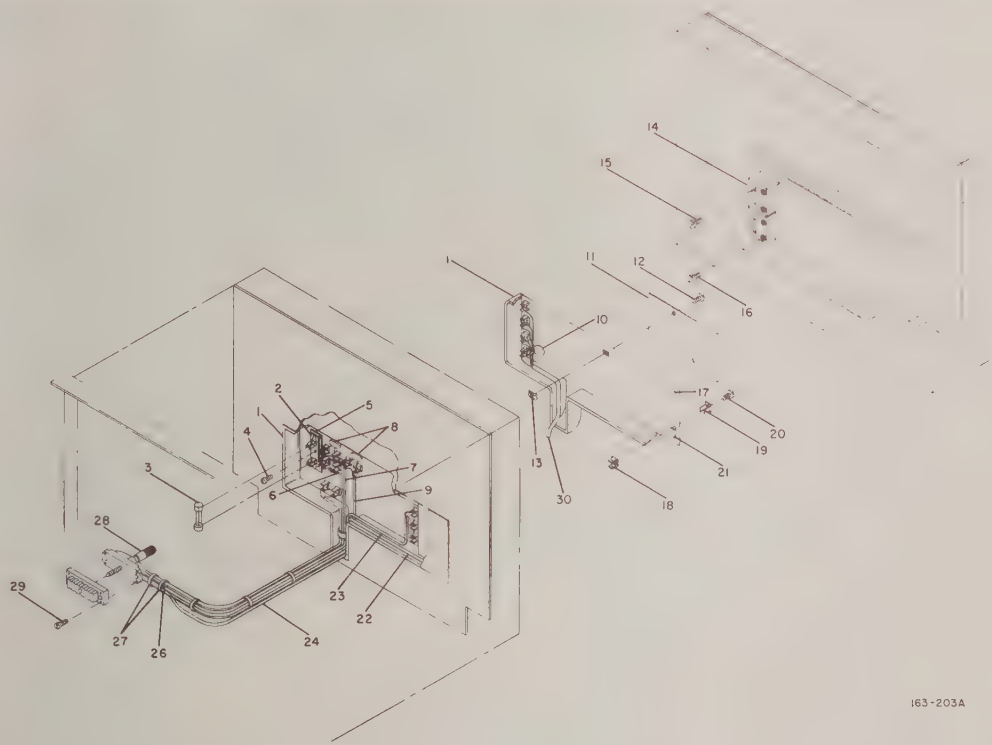


Figure 1. Terminal Panel Assembly

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1		terminal panel ass'y (see table)		1
1	370853-1	terminal panel		1
2	72224	fuse block		1
3	351949-6	fuse - (package of two - all actuations except lab recorder)	X	1
	351949-7	fuse - (package of two - lab recorder only)	X	1

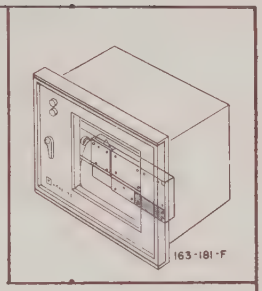
Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
4	5-804	screw - 8-32 binding hd. 1/4"		1
5	372805-1	insulator		1
6	370899-1	cable ass'y (l.h. 3-way operation pen)		1
7	370891-1	cable ass'y. (l.h. & r.h. operation pen)		1
8	370848-1	capacitor (.02 mfd)		5
9	370849-1	cable ass'y (upper pen lifter)		1
10	370874-1	capacitor		1
11	370875-1	cover		see table
12	5-805	screw - 8-32 binding hd. 5/16"		see table
13	724065-1	speed nut		see table
14	723103-1	t/c resistor ass'y.		1
15	5-816	screw - 8-32 binding hd. 1"		2
	9-808	screw - 8-32 washer hd. 1/2"		2
16	9-820	screw - 8-32 washer hd. 1-1/4"		2
	9-808	screw - 8-32 washer hd. 1/2"		2
17	368743-2	purple dot		1
18	371301-1	terminal fast on type		see table
19	70441	terminal clamp		see table
20	9-808	screw - 8-32 washer hd. 1/2"		see table
21	368743-1	red dot		1
22	370881-1	input cable #1 (pen drag servo - lower pen)		1
23	372801-2	cable ass'y. (remote 2 speed chart drive)		1
24	370881-3	input cable #2 (pen drag servo - upper pen)		1
25	370849-1	cable ass'y. (lower pen lifter on print holdout)		1
26	370887-1	support		1
27	371564-907	cable tie		A.R.
28	370865-1	connector		1
29	8-404	screw - 4-40 fillister hd. 1/4"		2
30	370888-1	cable ass'y. (power)		1

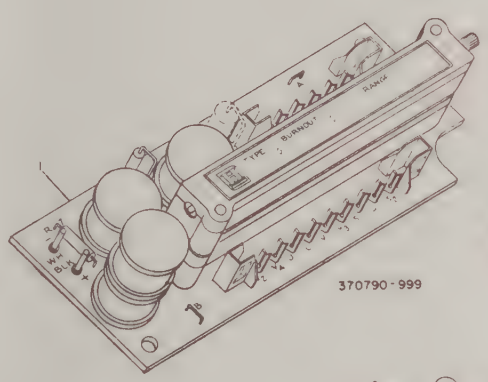
TABLE I

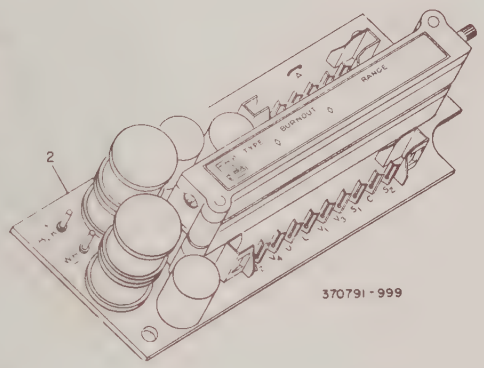
Terminal Panel Ass'y.	Cover	Screw (5-805)	Terminal Fast on Type	Terminal Clamp	Screw (9-808)	Speed Nut
	Quantity	Quantity	Quantity	Quantity	Quantity	Quantity
370868-1	1	2	30	30	22	2
370868-2	-	-	58	58	50	-
370868-3	1	2	30	30	22	2
370868-4	-	-	58	58	50	-

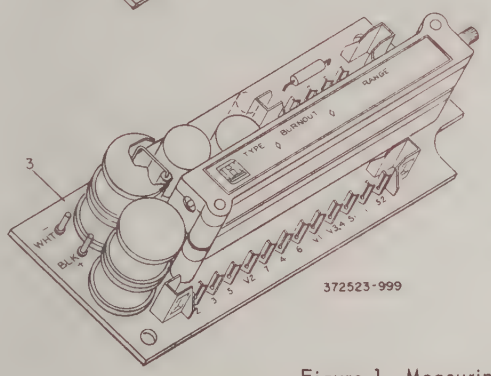
MEASURING CIRCUIT

PARTS LIST









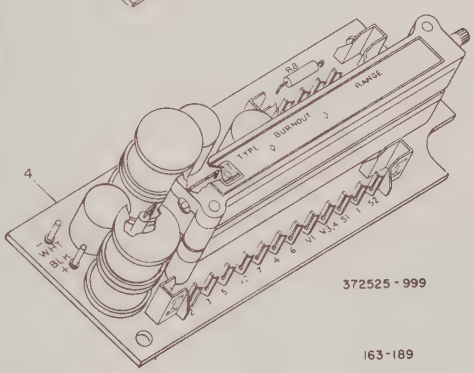


Figure 1. Measuring Circuit Units

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1				
1	370790-999	measuring circuit ass'y. - for T.C., M.V., D.C. volt, tachometer, D.C. current and radiomatic actuations		1
2	370791-999	measuring circuit ass'y. - for resistance thermometer		1
3	372523-999	measuring circuit ass'y. - for millivolt, thermocouple, D.C. volt, D.C. current, radiomatics, up & down scale burnouts & tachometer (stranducer)		1
4	372525-999	measuring circuit ass'y. - resistance thermometer (stranducer)		1

CONSTANT VOLTAGE UNIT

PARTS LIST

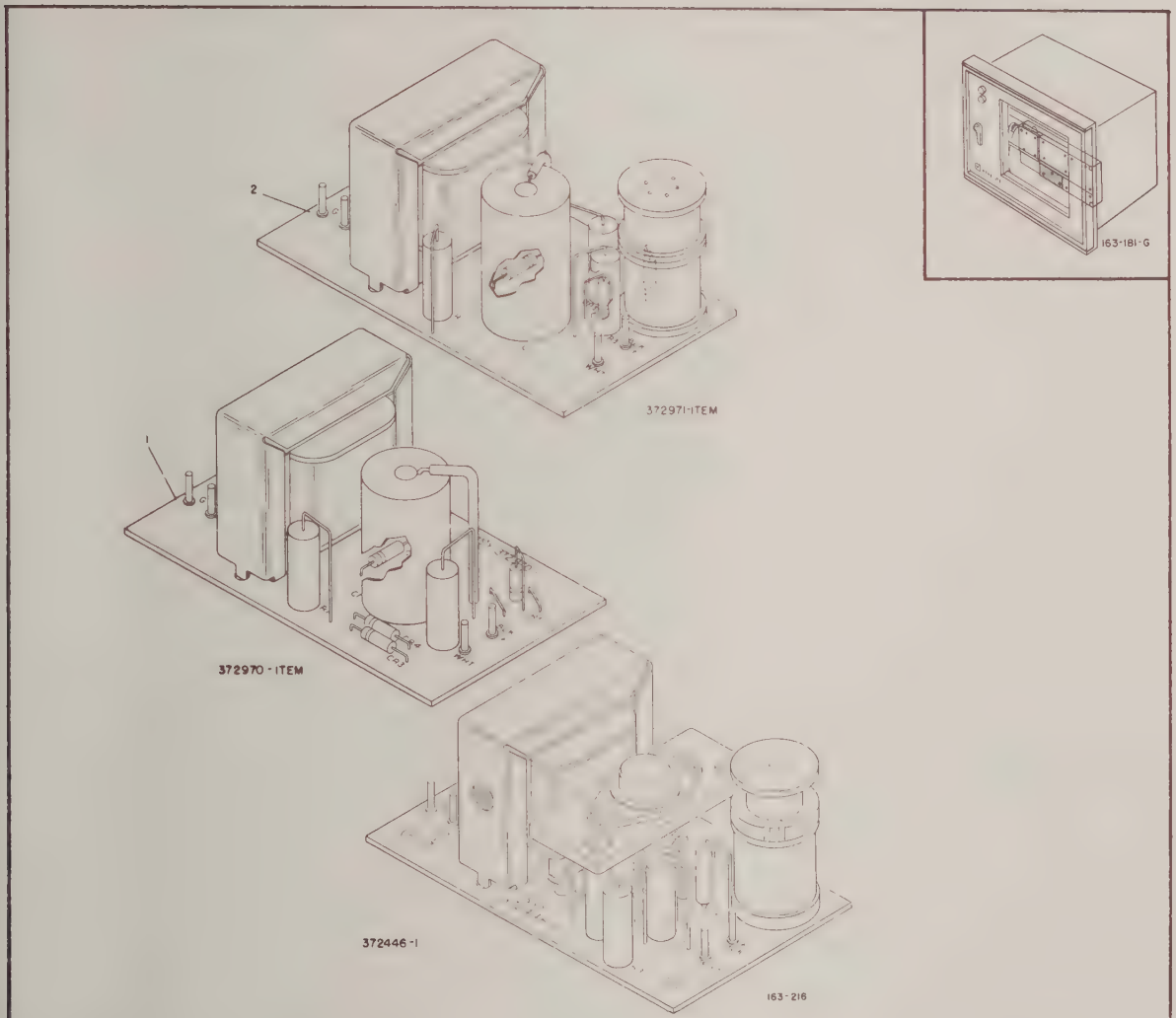
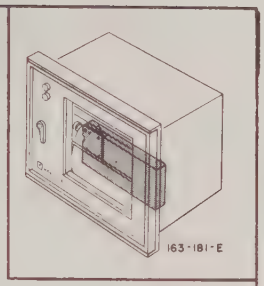


Figure 1. Constant Voltage Unit

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1				
1	372970-501	service replacement CVU - resistance thermometer & slidewire (low temperatures)		1
	372970-502	service replacement CVU - resistance thermometer & slidewire (high temperatures)		1
2	372971-501	service replacement CVU - M.V. & T/C actuations (low temperatures)		1
	372971-502	service replacement CVU - M.V. & T/C actuations (high temperatures)		1
3	372446-501	service replacement CVU - stranducer		1

SERVO CIRCUIT UNIT ASSEMBLY (SINGLE END AMPLIFIER)

PARTS LIST



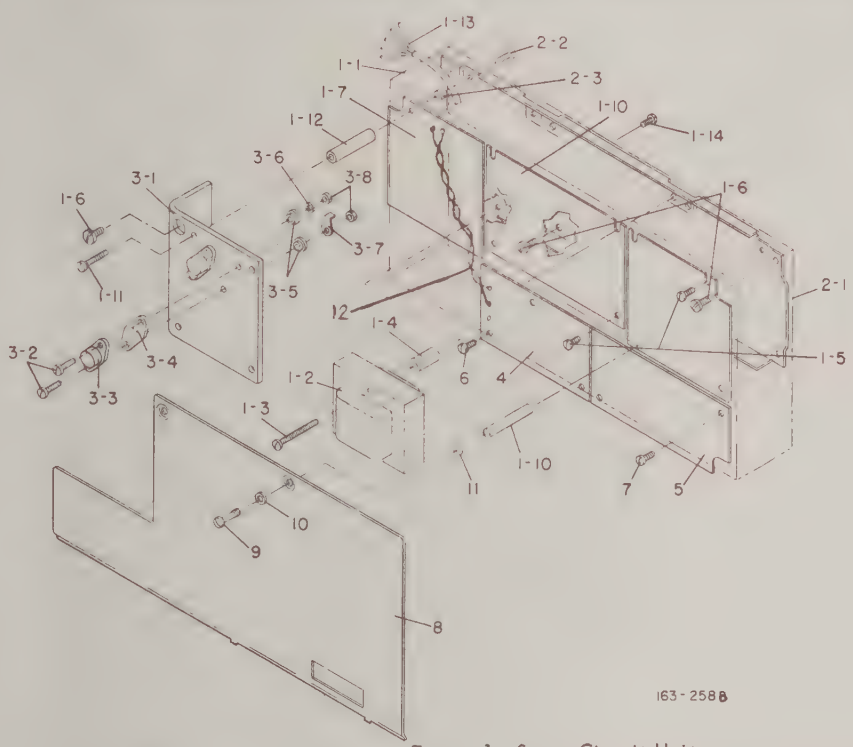


Figure 1. Servo Circuit Unit

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1				
	374577-item	servo circuit unit as (push-pull - see table I)		1
1	374578-item	amplifier ass'y. (see table II)	X	1
2	370736-1	chassis assembly		1
2-1	370731-1	chassis		1
2-2	5-608	screw - 6-32 binding hd. - 1/2"		4
2-3	370730-1	spacer		4
3	373317-1	heat sink ass'y.		1
3-1	370741-3	heat sink		1
3-2	5-608	screw		4
3-3	723423-9	transistor	X	2
3-4	373315-1	mica - insulator		2
3-5	373316-1	insulating washer		4
3-6	73644	lockwasher		4
3-7	351944	terminal		2
3-8	4906	nut		4
4	see table I	*constant voltage unit board		1
5	see table I	*measuring circuit board		1

*See separate parts list for component parts.

TABLE I

Key No.	Part Number	DESCRIPTION	SERVO CIRCUIT UNIT												
			374577-501 (one pen)	374577-502 (one pen with A. R. U.)	374577-503 (two pen)	374577-504 (two pen with A. R. U.)	374577-505 (one pen w/R. T.)	375477-506 (two pen W/R. T.)	374577-507 (one pen w/stranducer)	374577-508 (two pen w/stranducer)	374577-509 (one pen stranducer)	374577-510 (two pen stranducer (R/T.)	Recommended Spare Part	374577-515 (one pen high impedance)	374577-516 (two pen high impedance)
1	374578-501	amplifier ass'y.	1	-	1	-	1	1	-	-	-	-		-	-
	374578-502	amplifier ass'y.	-	1	-	1	-	-	-	-	-	-		-	-
	374578-503	amplifier ass'y.	-	-	-	-	-	-	1	1	1	1		1	1
	374578-505	amplifier ass'y	-	-	-	-	-	-	-	-	-	-		-	-
4	372970-1	constant voltage unit board	-	-	-	-	1	1	-	-	-	-		-	-
	372971-1	constant voltage unit board	1	1	1	1	-	-	-	-	-	-		-	-
	372971-2	constant voltage unit board	-	-	-	-	-	-	-	-	-	-		1	1
	372446-1	constant voltage unit board	-	-	-	-	-	-	1	1	1	1		-	-
5	370790-999	measuring circuit board	1	1	1	1	-	-	-	-	-	-		1	1
	370791-999	measuring circuit board	-	-	-	-	1	1	-	-	-	-		-	-
	372523-999	measuring circuit board	-	-	-	-	-	-	1	1	-	-		-	-
	372525-999	measuring circuit board	-	-	-	-	-	-	-	-	1	1		-	-
6	5-403	screw - 4-40 binding hd. 3/16"	4	4	4	4	4	4	4	4	4	4		4	4
7	372920-1	screw	2	2	2	2	2	2	2	2	2	2		2	2
8	370744-1	cover	1	1	1	1	1	1	1	1	1	1		1	1
9	372919-1	screw	2	2	2	2	2	2	2	2	2	2		2	2
10	78196	washer	2	2	2	2	2	2	2	2	2	2		2	2
11	354697-15	o' ring	2	2	2	2	2	2	2	2	2	2	X	2	2
12	370649-1	cable ass'y.	1	1	1	1	1	1	1	1	1	1		1	1

SERVO CIRCUIT ASSEMBLY (SINGLE END AMPLIFIER),

PARTS LIST

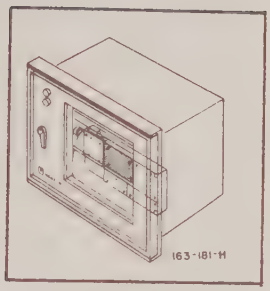
TABLE II

Key No.	Part Number	DESCRIPTION	AMP. ASS'Y. 374578-501 (plain)	374578-502 (with A.R.U.)	374578-503 (stranducer)	Recommended Spare Part	374578-504 (high impedance)
1-1	370749-2	case ass'y.	1	1	1		1
1-2	370696-2	power transformer	1	1	1		1
1-3	6-614	screw - 6-32 round hd. 7/8"	2	2	2		2
1-4	370738-2	spacer	2	2	2		2
1-5	5-404	screw - 4-40 binding hd. 1/4"	6	6	6		6
1-6	5-603	screw - 6-32 binding hd. 3/16"	4	4	4		4
1-7	374351-2	*power board ass'y.	1	1	1		1
1-8	374425-1	*amplifier board ass'y.	1	1	1	X	
	374351-2	*amplifier board ass'y.	-	-	-		1
1-9	370797-4	*input board ass'y.	1	1	-		
	372251-2	*input board ass'y.	-	-	1		
	374642-1	*input board ass'y.	-	-	-		1
1-10	370739-1	stud	2	2	2		2
1-11	5-606	screw - 6-32 binding hd. 3/8"	4	4	4		4
1-12	370738-1	post	4	4	4		4
1-13	370794-2	ribbon cable	1	1	1		1
1-14	5-604	screw - 6-32 binding hd. 1/4"	2	2	2		2
2	370736-1	chassis ass'y.	1	1	1		1
3	373317-2	heat sink ass'y.	1	1	1		1

See separate parts list for component parts

AMPLIFIER BOARD

PARTS LIST



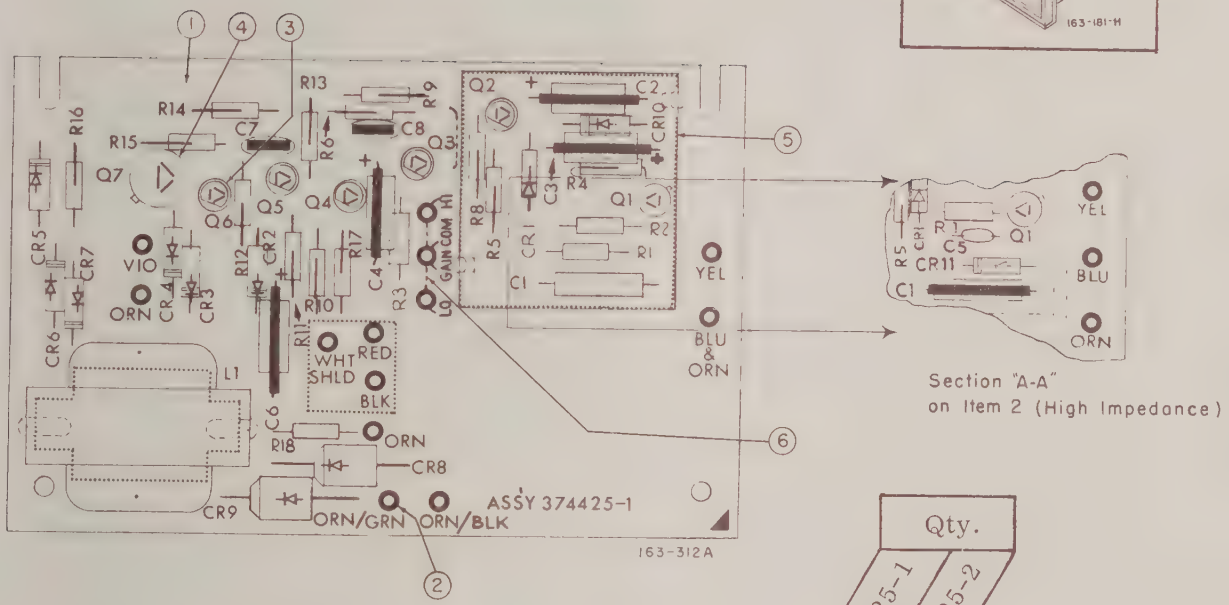


Figure 1. Amplifier Board Assembly

Item	Part No.	Description	Qty. 374425-1	Qty. 374425-2	Recommended Spare Part
	374425-1	Amplifier Board Ass'y			X
	374425-2	High Impedance Amplifier Board Ass'y			X
1	374424-1	Printed wiring board	1	–	
	374468-2	Printed wiring board		1	
2	371395-12	Connector pin	13	13	
3	372411-1	small transistor pad (for Q1 thru Q6)	6	6	
4	373365	large transistor pad (for Q7)	1	1	
5	374468-1	Can		1	
	374468-2	Can	1		
6	724535-903	Jumper	1	1	
L-1	374426-1	Choke	1	1	

Item	Part No.	Description	Qty. 374425-1	Qty. 374425-2	Recommended Spare Parts
R1	687901-4	Resistor 1 K Metal Film	0	1	
R1	105-106	Resistor 10 MΩ 1/4 W. 5%	1	0	
R2	105-105	Resistor 1 M Ω 1/4 W. 5%	1	0	
R3	105-271	Resistor 270Ω 1/4 W. 5%	1	0	
R4	687901-17	Resistor 10 K 1/4 W. 5%	1	1	
R5 R6 R15	105-103	Resistor 10 K 1/4 W. 5%	3	3	
R3	105-470	Resistor 47Ω 1/4 W. 5%	0	1	
R8 R13	105-104	Resistor 100 K 1/4 W. 5%	2	2	
R9	105-102	Resistor 1 K 1/4 W. 5%	1	1	
R10	105-333	Resistor 33 K 1/4 W. 5%	1	1	
R11 R14	105-823	Resistor 33 K 1/4 W. 5%	2	2	
R12	105-334	Resistor 330 K 1/4 W. 5%	1	1	
R16 R17	105-471	Resistor 470Ω 1/4 W. 5%	2	2	
R18	105-121	Resistor 120Ω 1/4 W. 5%	1	1	
C1	723146-16	Capacitor 0.01μf	0	1	
C2 C4 C6	374391-414	Capacitor 10μf 20 V.	3	3	
C3	374391-294	Capacitor 1μf 20 V.	1	1	
C5	722521-3	Capacitor .001μf	0	1	
C7	353818-9	Capacitor 16 pf 500 V,	1	1	
C8	369562-3	Capacitor 0.02μf 50 V.	1	1	

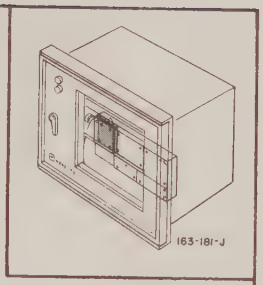
AMPLIFIER BOARD

PARTS LIST

Item	Part No.	Description	Qty. 374425-1	Qty. 374425-2	Recommended Spare Parts
CR1 CR2 CR3 CR4	723408-10	Diode IN459	4	5	X
CR5	369764-21	Diode Zener 12 V ±10%	1	1	
CR6 CR7 CR10	369764-36	Diode Zener IN756A	3	3	
CR8 CR9	723408-2	Diode IN2069	2	2	
CR11	723408-10	Diode IN459	0	-	
Q1	374470-1	Transistor F. E. T.	1	0	X
Q2 Q3 Q4 Q5 Q6	723626-24	Transistor 2N2924	5	5	X
Q7	723626-9	Transistor 2N697	1	1	
Q1	374470-3	Transistor F. E. T.	0	1	

POWER BOARD

PARTS LIST



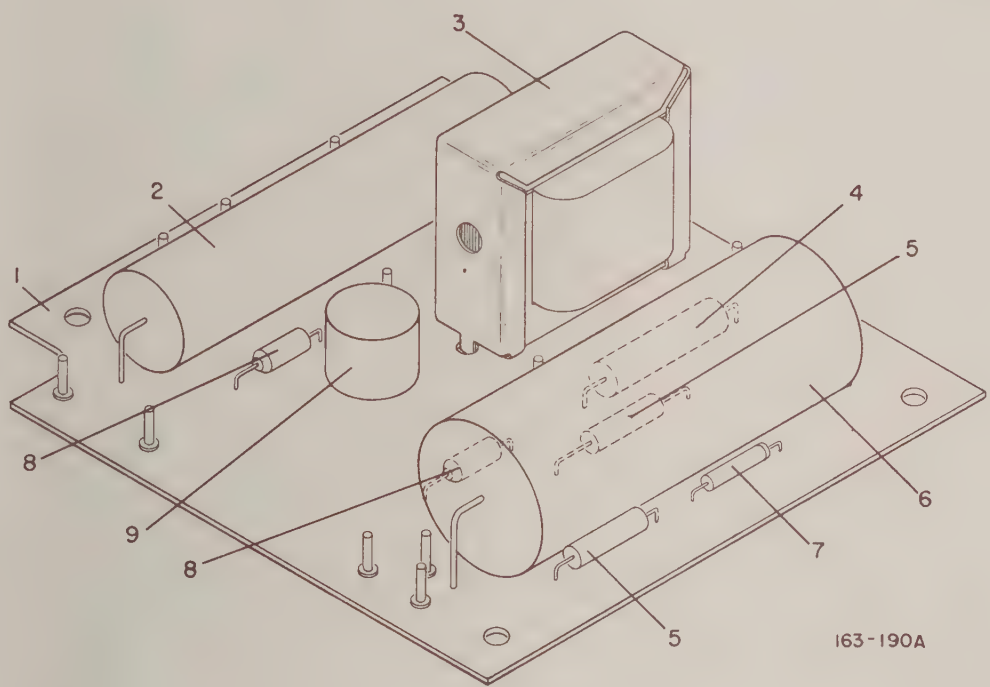
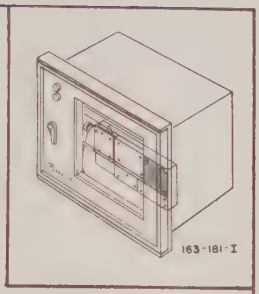


Figure 1. Power Board Assembly

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1	370754-1	power board ass'y.		1
1	370753-1	board		1
2	723545-1	capacitor (C13) (1.0 mfd)		1
3	723413-1	transformer (T-3)		1
4	74701-28	resistor (R-17) (1.0 ohm)		1
5	210-472	resistor (R-18, R-19) (4.7k)		2
6	723410-1	capacitor (C14) (130 mfd)		1
7	723408-10	diode (CR-5) (50 ma)	X	1
8	723408-2	diode (CR-3, CR-4) (750 ma)	X	2
9	723444-10	capacitor (C15) (10 mfd)		1

INPUT BOARD ASS'Y.

PARTS LIST



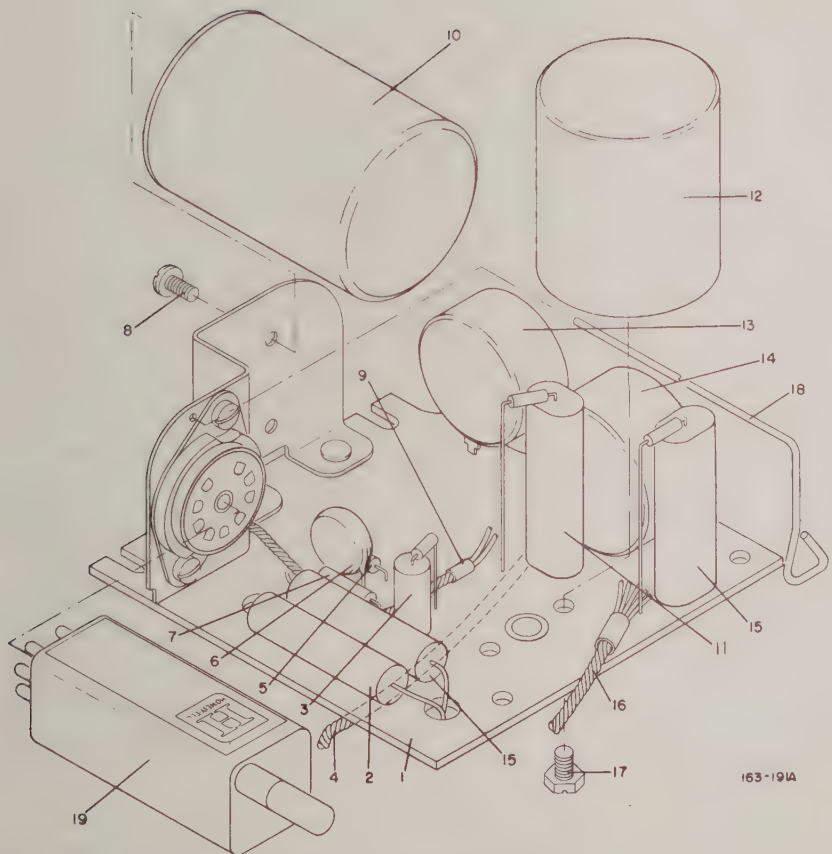


Figure 1. Input Board Assembly

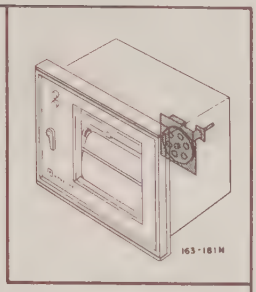
Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1				
1	370797-item	input board assembly (see table I for component parts)		1

TABLE I

Key No.	Part Number	Description	INPUT BOARD ASS'Y. 370797-1 All Actuations	370797-2 Multi-point	370797-3 Hi-speed .2 sec. Amplifier	Recommended Spare Parts
1	370796-1	board assembly	1	1	-	
	370796-3	board assembly	-	-	1	
2	374412-374	capacitor (C_B) (2.5 mfd)	1	-	-	
	374412-294	capacitor (C_B) (.50 mfd)	-	1	-	
	723146-3	capacitor (C_B) (1.0 mfd)	-	-	1	
3	687735-445	resistor (RC) (95k)	1	-	1	
	687735-619	resistor (RC) (261k)	-	1	-	
4	370827-1	cable - with receptacles	1	-	1	
	372285-1	cable ass'y.	-	1	-	
5	210-183	resistor (RA) (18k)	1	1	-	
	210-153	resistor (RA) (15k)	-	-	1	
6	370798-1	capacitor (CA) (.025 mfd)	1	1	1	
7	210-103	resistor (R_B) (10k)	1	1	1	
8	19-605	screw - 6-32 tapping flat hd. - 5/16"	2	2	2	
9	370828-1	cable (without receptacles)	1	1	1	
10	370788-1	input transformer	1	1	1	
11	723146-2	capacitor (C_D) (.75 mfd)	1	-	-	
	374391-214	capacitor (C_D) (.22 mfd)	-	1	-	
	723146-1	capacitor (C_D) (.56 mfd)	-	-	1	
12	372641-1	choke	1	1	1	
13	370787-1	gain pot. (R_G) (50k)	1	-	1	
	370787-2	gain pot. (R_G) (20k)	-	1	-	
14	370786-1	damping pot. (R_D) (4k)	1	1	1	
15	374391-294	capacitor (C_C) (1.0 mfd)	1	1	-	
	723146-3	capacitor (C_C) (1.0 mfd)	-	-	1	
16	370762-1	cable ass'y.	1	1	1	
17	359316-2	screw	2	2	2	
18	370752-1	clamp	1	1	1	
19	723984-7	converter	1	1	1	X

SERVO DRIVE
(½,1,3,5, & 15 Sec.)

PARTS LIST



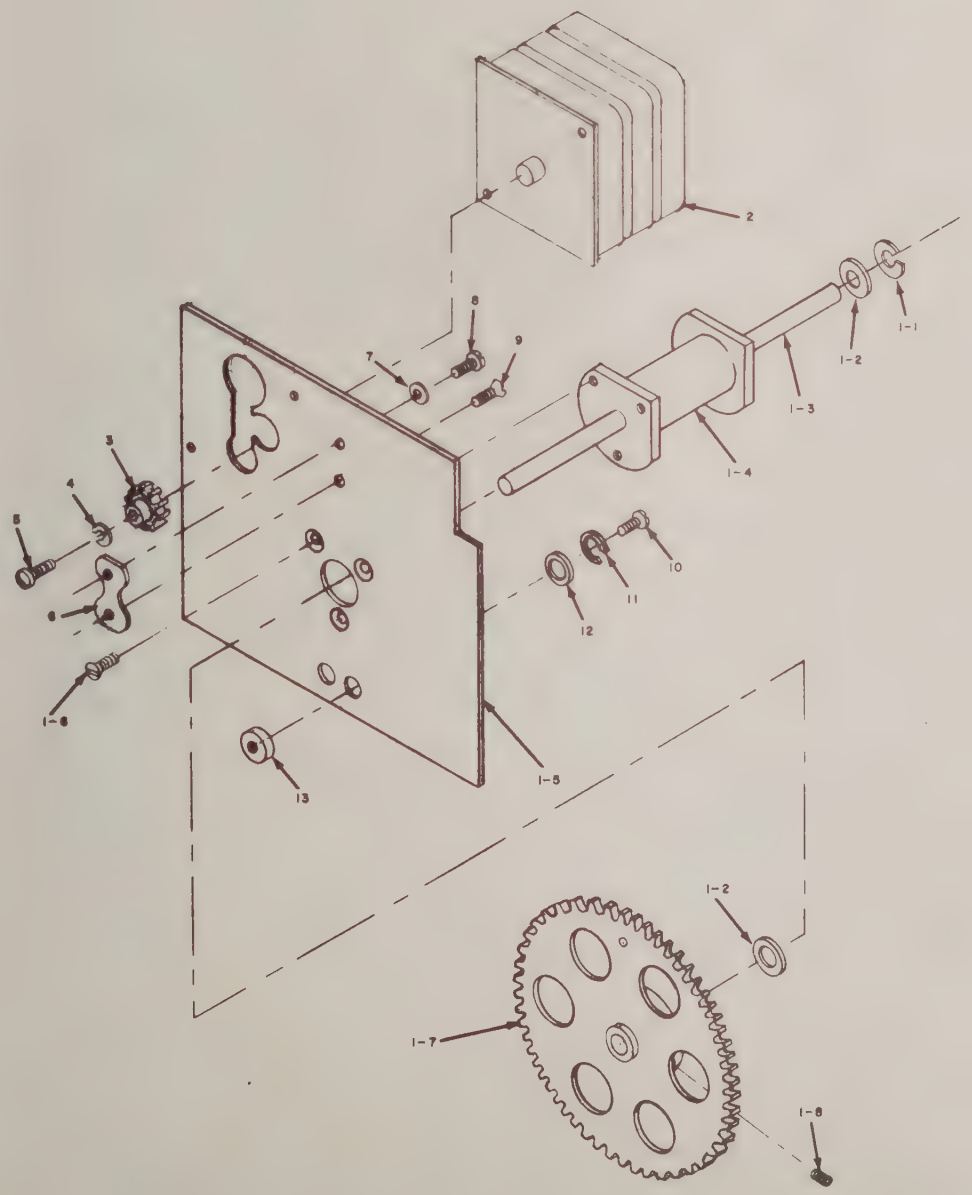


Figure 1. Servo Drive Assembly (½, 1, 3, 5 & 15 sec.) 163-201A

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1				
		servo drive ass'y. (1/2 & 1 sec.)		
		servo drive ass'y. (3, 5 & 15 sec.)		
1	370266-1	servo plate ass'y. (1/2 & 1 sec.)		1
	370250-1	servo plate ass'y. (3, 5 & 15 sec.)		1
1-1	371539-210	retaining ring		1
1-2	370265-1	thrust washer		2
1-3	370264-1	shaft		1
1-4	370256-1	bearing housing		1
1-5	372578-1	plate (1/2 sec.)		1
	372579-1	plate (1 sec.)		1
	370255-1	plate (3, 5 & 15 sec.)		1
1-6	7-806	screw - 8-32 flat hd. 3/8"		3
1-7	370276-1	gear ass'y. - 288T (1/2 & 1 sec.)		1
	370260-1	gear ass'y. - 160T (3, 5 & 15 sec.)		1
1-8	17-806	setscrew		1
2	*365755-4	motor (1/2 sec.)	X	1
	365755-3	motor (1 sec.)	X	1
	*365754-10	motor (3, 5 & 15 sec.)	X	1
	365754-11	motor (5 & 15 sec.)	X	1
3	370253-1	pinion - 14T (5 & 15 sec.)		1
	370254-1	pinion - 24T (3 sec.)		1
4	78196	lockwasher (3, 5 & 15 sec.)		1
5	5-604	screw - 6-32 binding hd. 1/4" (3, 5 & 15 sec.)		1
6	370288-1	stop (11")		1
	370287-1	stop (10" & 10-1/2")		1
7	9771	lockwasher		1
8	5-805	screw - 8-32 binding hd. 5/16"		1
9	7-804	screw - 8-32 flat hd. 1/4"		1
10	5-006	screw - 10-32 binding hd. 3/8"		1
11	9237	lockwasher		1
12	4971	washer		1
13	370286-1	stop (5")		1

* See separate parts list for component parts

SLIDEWIRE ASSEMBLY

PARTS LIST

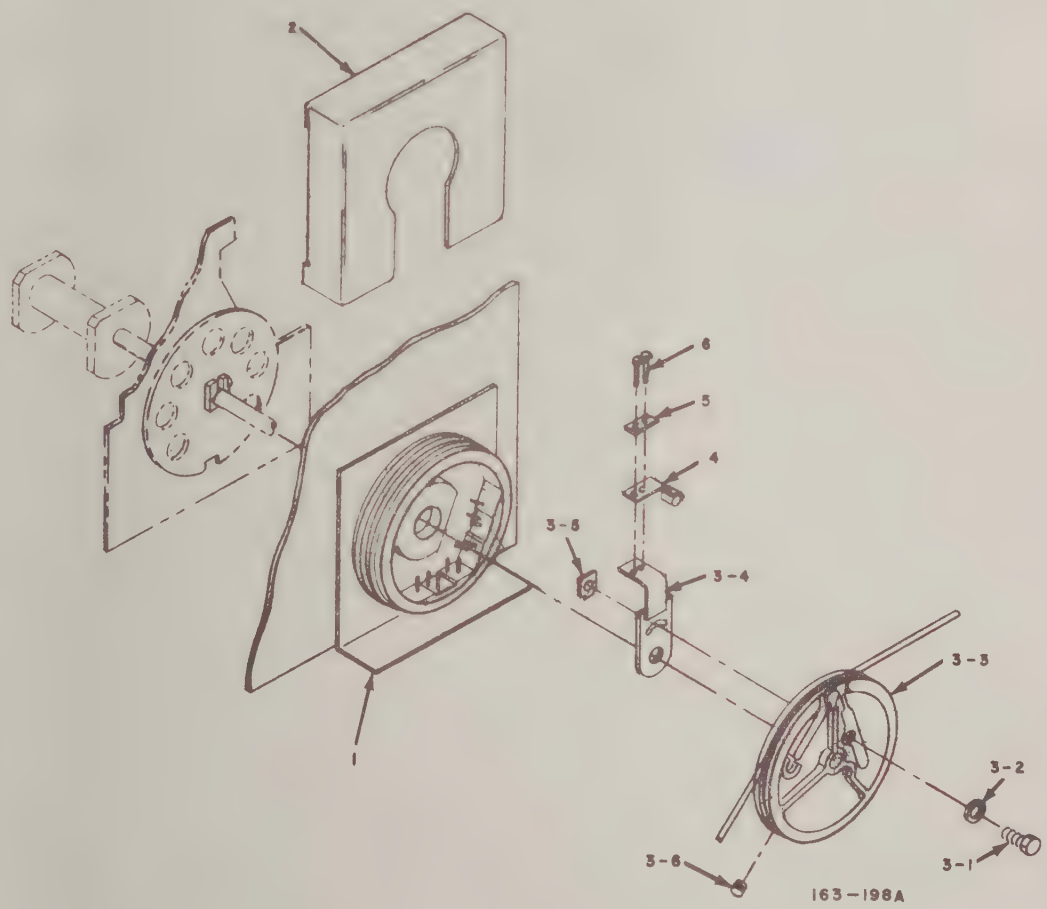


Figure 1. Slidewire Assembly

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1				
1	370801-501	slidewire ass'y. (single range)	X	1
	370801-502	slidewire ass'y. (dual range)	X	1
2	370816-1	cover		1
3	370804-1	pulley ass'y. (multi-point)		1
	370804-2	pulley ass'y. (one & two pen)		1

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
3-1	8-812	screw - 8-32 fillister hd. 3/4" (multipoint)		1
	8-816	screw - 8-32 fillister hd. 1" (one & two pen)		1
3-2	357621	washer		1
3-3	370290-1	pulley (multi-point)		1
	370290-2	pulley (one & two pen)		1
3-4	370813-1	wiper arm ass'y.		1
3-5	370823-1	clamp		1
3-6	17-806	set screw		1
4	370811-1	contact ass'y.	X	1
5	371139-1	insulator		1
6	5-402	screw - 4-40 binding hd. 1/8"		2

SERVO MOTOR (3, 5, 15 sec.)

PARTS LIST

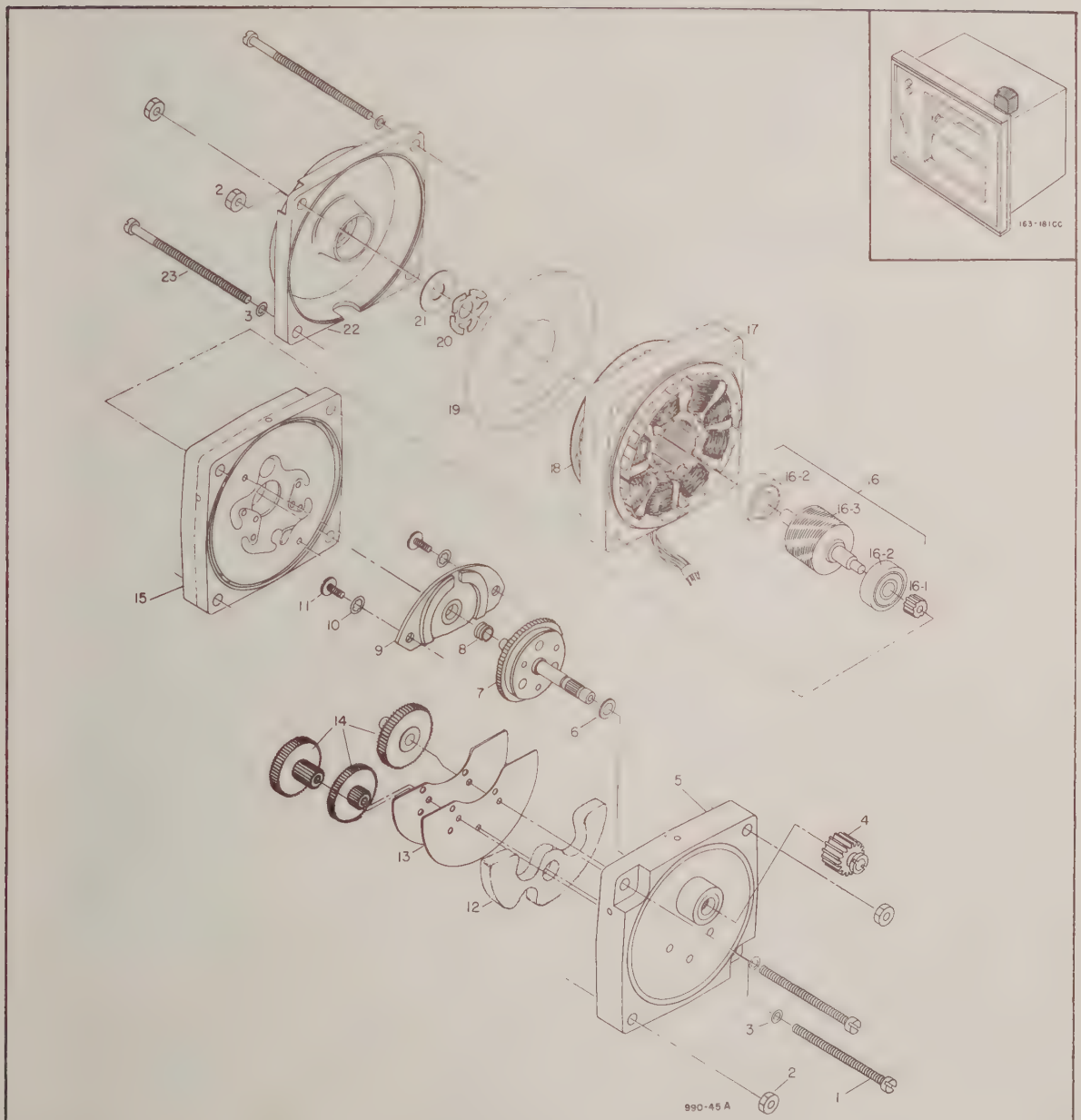


Figure 1. Motor Assembly.

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1	see table 1	For service replacement motor assembly		
	see table 2	For gear assemblies for motors		
	see table 3	For components parts for motors		
	see table 4	For tool kit and components		

Motor part numbers depend upon motor speed; to order parts for your specific motor, see the following:

TABLE 1

Service Replacement Part Number	Gear Ratio	120 Volts Frequency (c.p.s.)	R.P.M.	Used ON
365754-501	60:1	50-60	23	Cl. 17 - 5 sec.
-503	10:1	50-60	144	Cl. 18 - 5 sec.
-504	30:1	50-60	48	Cl. 18 - 15 sec.
-505	10:1	50-60	144	Cl. 18 - 1 sec.
-506	10:1	50-60	144	Cl. 15 - 4 1/2 sec.
-507	30:1	50-60	48	Cl. 15 - 12 sec.
-508	60:1	50-60	23	Cl. 15 - 24 sec.
-509	4.4:1	50-60	330	Cl. 15 - 2 sec.
-510	10:1	50-60	144	Cl. 16 - 3 & 5 sec.
-511	30:1	50-60	48	Cl. 16 - 15 sec.
-512	10:1	50-60	144	Cl. 15 - 1 sec.

TABLE 3

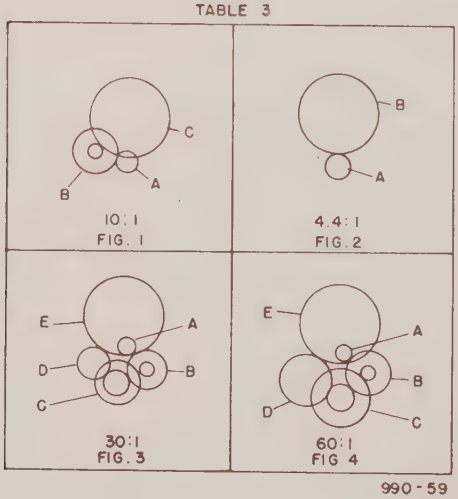


Figure 2. Gear Ratio.

TABLE 2 - GEAR ASSEMBLIES

RATIO	365754 ITEM
10:1	
A	362442 (15T)
B	369844-1 (35T & 14T)
C	353213 (60T)
4.4:1	
A	362440-2 (10T)
B	362448 (44T)
30:1	
A	362441 (11T)
B	369847-1 (42T & 12T)
C	364784 (44T & 28T)
D	364838-1 (28T)
E	353213 (60T)
60:1	
A	362441 (11T)
B	369847-1 (42T & 12T)
C	364786 (44T & 14T)
D	364838-2 (46T)
E	353213 (60T)

SERVO MOTOR (3, 5, 15 sec.)

PARTS LIST

TABLE 3

KEY NO.	PART NO.	DESCRIPTION	SERVICE REPLACEMENT PART NUMBER 365754 - ITEM									
			501	503	504	505	506	507	508	509	510	511	512
1	355018-12	Screw (2)	X	X	X	X	X	X	X	X	X	X	X
2	5966	Nut (4)	X	X	X	X	X	X	X	X	X	X	X
3	925	Lockwasher (4)	X	X	X	X	X	X	X	X	X	X	X
4	362423	Pinion	-	-	-	-	X	X	X	X	-	-	-
4	371299-1	Pinion	-	X	X	-	-	-	-	-	-	-	-
5	365537-1	Gear Housing	-	-		-	-	-	-	X	-	-	-
5	365537-2	Gear Housing	-	X	-	X	X	-	-	-	X	-	X
5	365537-5	Gear Housing	-	-	X	-	-	X	-	-	-	X	-
5	365537-6	Gear Housing	X	-		-	-	-	X	-	-	-	-
6	362426	Spacer	X	X	X	X	X	X	X	X	X	X	X
7	365539-1	Output Shaft Assembly	-	X	X	-	X	X	X	-	-	-	-
7	365539-3	Output Shaft Assembly	X	-	-	X	-	-	-	-	X	X	X
7	365543-1	Output Shaft Assembly		-	-	-	-	-	-	X	-	-	-
8	362478-2	Spacer	X	X	X	X	X	X	X	-	X	X	X
8	71958	Spacer	-		-	-	-	-	-	X	-	-	-
9	362410-1	Bearing Plate	X	X	X	X	X	X	X	-	X	X	X
9	362410-2	Bearing Plate	-	-	-	-	-	-	-	X	-	-	-
11	79065-3	Screw (2)	X	X	X	X	X	X	X	X	X	X	X
12	362486	Oil Wick	X	X	X	X	X	X	X	-	X	X	X
13	362487-1	Wick Retainer (2)	X	X	X	X	X	X	X	-	X	X	X
14	-	Gear Assemblies (See Table 3)											
15	365542	Housing & Wick Assembly	X	X	X	X	X	X	X	X	X	X	X
16	362416-501	Rotor Shaft Assembly	-	X	-	X	X	-	-	-	X	-	X
16	362416-502	Rotor Shaft Assembly	-	-	X	-	-	X	X	-	-	X	-
16	362416-504	Rotor Shaft Assembly	-	-	-	-	-	-	-	X	-	-	-
16	362416-505	Rotor Shaft Assembly	X	-	-	-	-	-	-	-	-	-	-
16-1	362442	Pinion	-	X	-	X	X	-	-	-	X	-	X
16-1	362441	Pinion	X	-	X	-	-	X	X	-	-	X	-
16-1	362440-2	Pinion	-	-	-	-	-	-	-	X	-	-	-
16-2	362493	Ball Bearing (2)	X	X	X	X	X	X	X	X	X	X	X
16-3	362417-1	Armature	-	X	X	X	X	X	X	X	X	X	X
16-3	362417-3	Armature	X	-	-	-	-	-	-	-	-	-	-
*17	365458-11	Stator & Cable Assembly	X	-	-	-	-	-	-	-	-	-	-
*17	365458-12	Stator & Cable Assembly	-	X	X	X	-	-	-	-	-	-	-
*17	365458-13	Stator & Cable Assembly	-	-	-	-	X	X	X	-	-	-	X
*17	365458-14	Stator & Cable Assembly	-	-	-	-	-	-	-	X	-	-	-
*17	365458-15	Stator & Cable Assembly	-	-	-	-	-	-	-	-	X	X	-
18	362475	Printed Circuit Plate	X	X	X	X	X	X	X	X	X	X	X
19	362628	Insulator	X	X	X	X	X	X	X	X	X	X	X
20	362398	Spring	X	X	X	X	X	X	X	X	X	X	X
21	362455-1	Washer (as req'd)	X	X	X	X	X	X	X	X	X	X	X
22	362415	Housing	X	X	X	X	X	X	X	X	X	X	X
23	355018-8	Screw (2)	X	X	X	X	X	X	X	X	X	X	X

* Not yet available as an assembly as listed.

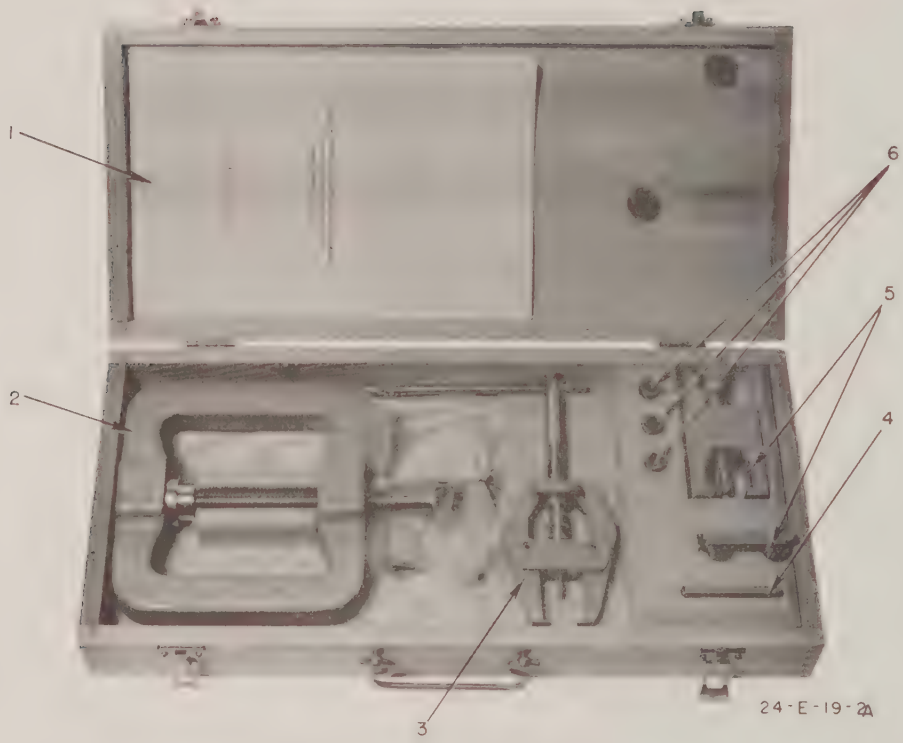


Figure 3. Tool Kit and Components.

TABLE 4

KEY NO.	DESCRIPTION	HONEYWELL PART NO.	QTY.
3	complete tool kit	364950	1
1	case	365568-1	1
2	screw press	365535	1
3	puller for armature pinion and bearing	364402	1
4	pilot for inserting shaft post grease seal in gear housing	364399	1
5	puller for output pinion	364407	1
6	spacer for output shaft 362429	364397-1	1
	spacer for output shaft 362430	364397-2	1
	spacer for output shaft 362458	364397-3	1

REPLACEMENT TIPS		
Description	Part No.	Qty.
puller & press	678759-1	1
puller	678759-2	1
press	678759-3	1

SERVO MOTOR (1 & ½ sec.)

PARTS LIST

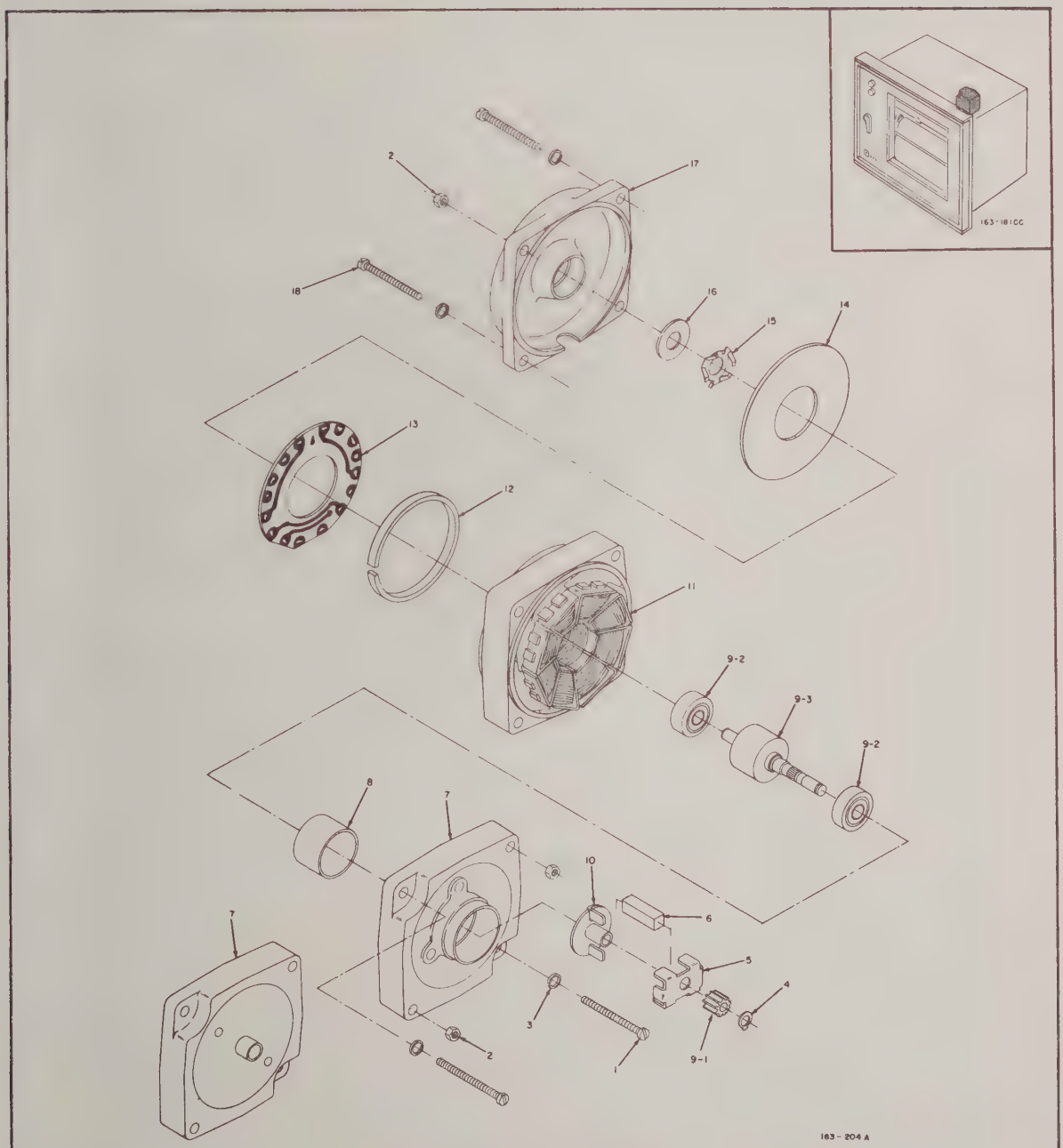


Figure 1. Motor Assembly.

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1	see table 1 see table 2	For service replacement motor assembly For components parts for motors		

Motor parts numbers depend upon motor speed; to order parts for your specific motor, see the following:

TABLE I

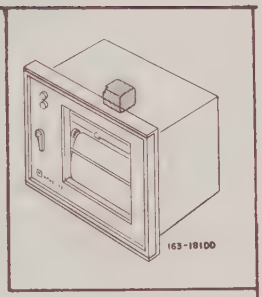
Service Replacement Part Number	120 Volts Frequency (c.p.s.)	R.P.M.	Used On
365755-501	50-60	1450	CL. 17 - 1 sec.
-502	50-60	1450	CL. 15 - 1 sec.
-503	50-60	1450	CL. 16 - 1 sec.
-504	50-60	1450	CL. 16 - 1/2 sec.
-505	50-60	1450	CL. 16 - 1 sec.
-506	50-60	1450	CL. 16 - 1/2 sec.

TABLE II

KEY NO.	PART NO.	DESCRIPTION	Service Replacement Part Number 365755-Item					
			501	502	503	504	505	506
1	30-141	screw (2) - 10-32 fillister hd. 1-1/8"	x	x	x	x	x	x
2	5966	nut (4)	x	x	x	x	x	x
3	925	lockwasher (4)	x	x	x	x	x	x
4	723015-5	cotter	-	-	x	x	x	x
5	372570-1	gear ass'y.	-	-	x	-	x	-
	372570-2	gear ass'y.	-	-	-	x	-	x
6	372577-1	cushion	-	-	x	x	x	x
7	365756-1	housing ass'y.	x	x	-	-	-	-
	370295-1	housing ass'y.	-	-	x	x	x	x
8	372297-1	sleeve	x	x	x	x	x	x
9	365757-1	rotor ass'y.	x	-	-	-	-	-
	365757-2	rotor ass'y.	-	x	-	-	-	-
	372574-1	rotor ass'y.	-	-	x	x	x	x
9-1	362440-2	pinion	x	-	-	-	-	-
	358553-002	pinion	-	x	-	-	-	-
	372570-1	pinion	-	-	x	-	x	-
	372570-2	pinion	-	-	-	x	-	x
9-2	362493	ball bearing (2)	x	x	x	x	x	x
9-3	372575-1	rotor shaft ass'y.	-	-	x	x	x	x
	372575-2	rotor shaft ass'y.	x	x	-	-	-	-
10	372567-1	hub ass'y.	-	-	x	x	x	x
11	362407-7	stator & housing ass'y.	x	x	x	x	-	-
	362407-8	stator & housing ass'y.	-	-	-	-	x	x
12	368451-1	nylon insulator	x	x	x	x	x	x
13	362475	printed wiring board	x	x	x	x	x	x
14	362628	insulator	x	x	x	x	x	x
15	362398	spring	x	x	x	x	x	x
16	362455-1	washer (as req'd.)	x	x	-	x	x	x
	362455-2	washer (as req'd.)	-	-	x	x	x	x
17	362415	housing	x	x	x	x	x	x
18	30-146	screw (2) - 10-32 fillister hd. 1-3/4"	x	x	x	x	x	x

PRINT MOTOR (60 c.p.s.)

PARTS LIST



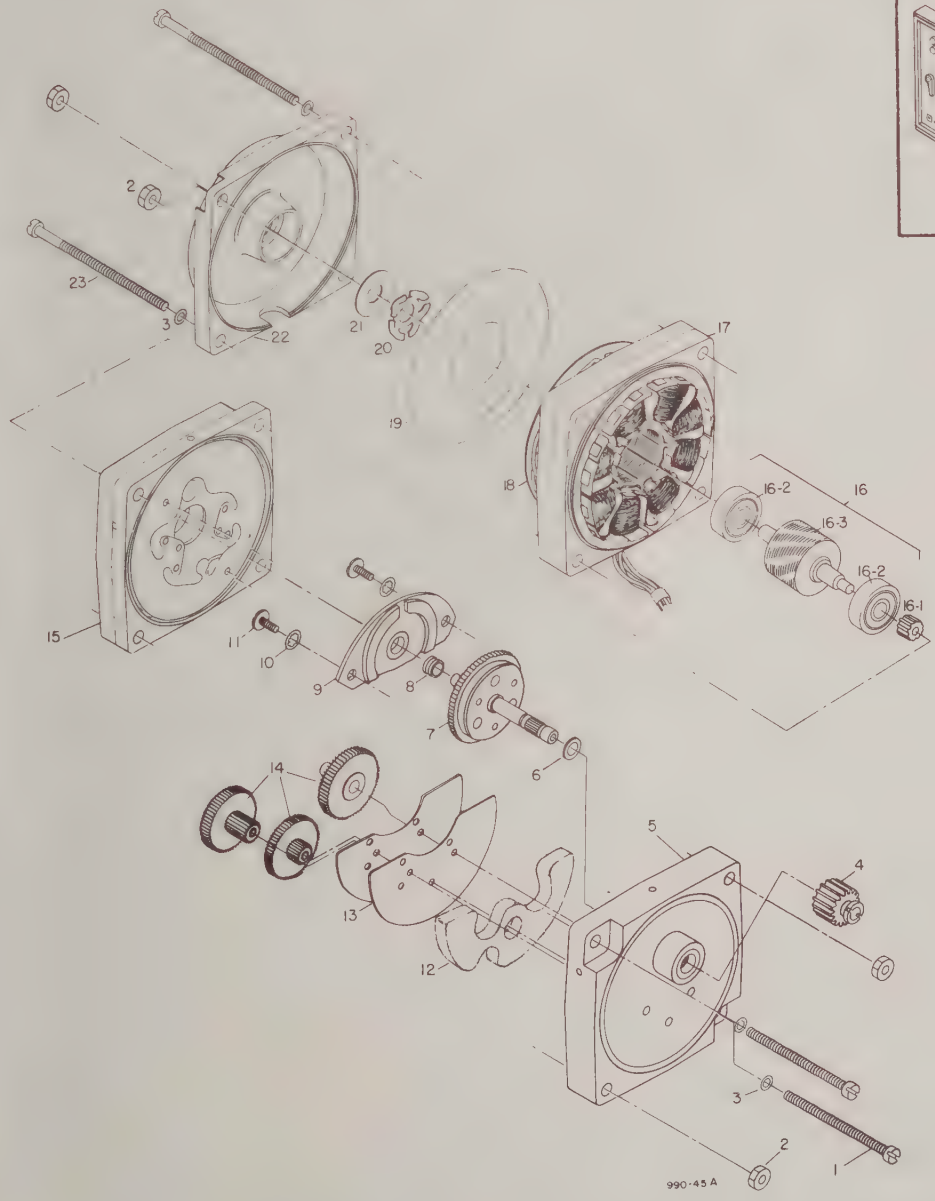


Figure 1. Motor assembly

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1	see table 1	service replacement motor assembly		
	see table 2	components parts for motors		
	see table 3	gear assemblies for motors		
	see fig. 3	tool kit and components		

TABLE 1

Service Replacement Part Number	Gear Ratio	120 Volts Frequency (c.p.s.)	R.P.M.	Torque (oz-in)
362479-501	10:1	50-60	144	23
-502	30:1	50-60	48	56
-503	60:1	50-60	23	105
-504	25:1	25	23	36
-505	12.5:1	25	46	18
-508	10:1	50-60	144	23
-509	30:1	50-60	48	56
-510	10:1	50-60	144	23
362481-501	10:1	50-60	180	12
-502	30:1	50-60	60	18
-503	60:1	50-60	30	36
-504	25:1	25	30	30
-505	12.5:1	25	60	15
-506	10:1	50-60	180	2
-507	20:1	50-60	90	12
-508	60:1	50-60	30	36
-509	10:1	50-60	180	12
-510	30:1	50-60	60	18
-511	60:1	50-60	30	36
-512	20:1	50-60	90	12
-513	10:1	60	180	12
-514	20:1	60	90	24
-515	30:1	60	60	36
-516	60:1	60	30	72

TABLE 2

KEY NO.	PART NO.	DESCRIPTION	SERVICE REPLACEMENT PART NUMBER																							
			362479-Item								362481-Item															
			501	502	503	504	505	508	509	510	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516
1	80-032	screw - 10-32 fil. hd. 2" (2)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	5966	nut (4)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	925	lockwasher (4)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	362423	pinion	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	362473	pinion	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	362424	pinion	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5	365537-2	gear housing	X	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	365537-3	gear housing	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	365537-4	gear housing	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	365537-5	gear housing	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	365537-6	gear housing	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	365541-1	gear housing	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-	X	-	-	-	X	-	-	-
5	365541-2	gear housing	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
5	365541-3	gear housing	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
5	365541-4	gear housing	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	X	-
5	365541-5	gear housing	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-	X	-	-	-	-	X
5	365541-6	gear housing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	X	-	-
6	362426	spacer	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7	365539-1	output shaft assembly	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	365539-2	output shaft assembly	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	365539-3	output shaft assembly	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	365540	output shaft assembly	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8	362478-2	spacer	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	362478-1	spacer	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
9	362410-1	bearing plate	X	X	X	-	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X
9	362474	bearing plate	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
10	78196	lockwasher (2)	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
11	79065-3	screw (2)	X	X	X	-	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X
11	76117	screw (2)	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
12	362486	oil wick	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
13	362487-1	wick retainer (2)	X	X	X	-	X	X	X	X	X	X	X	-	X	X	-	X	X	X	X	-	X	-	X	X
13	362487-2	wick retainer (2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	X	-	-
13	362487-3	wick retainer (2)	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
14	—	gear assemblies (see table 3)																								
15	365542	housing & wick assembly	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
16	362416-501	rotor shaft assembly	X	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	362416-502	rotor shaft assembly	-	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	362416-503	rotor shaft assembly	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	365249-501	rotor shaft assembly	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-	X	-	-	-	X	-	-	-
16	365249-502	rotor shaft assembly	-	-	-	-	-	-	-	-	-	X	X	-	-	-	X	X	-	X	X	X	-	X	X	X
16	365249-503	rotor shaft assembly	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-
16-1	362442	pinion	X	-	-	-	-	X	-	X	X	-	-	-	-	X	-	-	X	-	-	-	X	-	-	-
16-1	362441	pinion	-	X	X	-	-	-	X	-	-	X	X	-	-	-	X	X	-	X	X	X	-	X	X	X
16-1	362440-1	pinion	-	-	-	X	X	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-
16-2	362493	ball bearing (2)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
16-3	362417-1	armature	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-3	362417-2	armature	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
17	365458-1	stator & cable assembly	X	X	X	-	-	X	X	X	X	-	-	-	-	X	-	-	X	-	-	-	X	X	X	X
17	365458-8	stator & cable assembly	-	-	-	-	-	-	-	-	-	X	X	-	-	-	X	X	-	X	X	X	-	-	-	-
17	365458-3	stator & cable assembly	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	365458-9	stator & cable assembly	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-
18	362475	printed circuit plate	X	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	-	X	X	X	-	-	-	-
18	362476	printed circuit plate	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	X	X	X	X
19	362628	insulator	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
20	362398	spring	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
21	362455-1	washer (as req'd)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
22	362415	housing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
23	355018-3	screw (2)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

TABLE 3

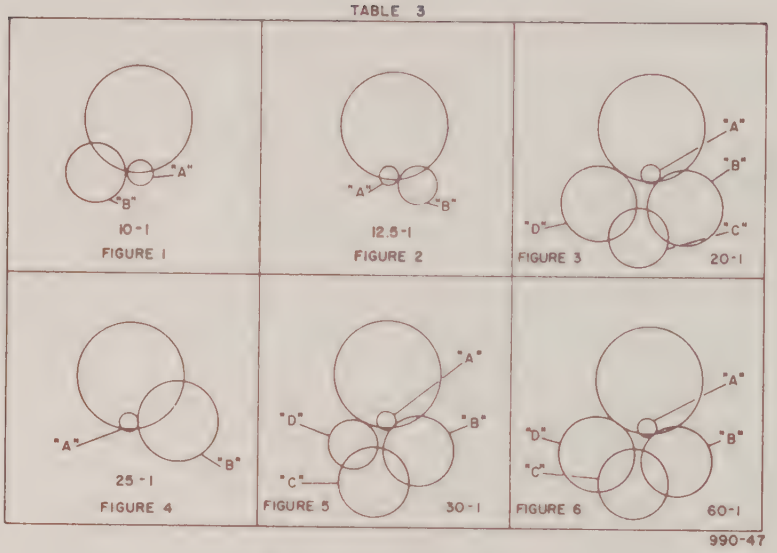


Figure 2. Gear ratio

TABLE 3 - GEAR ASSEMBLIES

Ratio	362479-Item	362481-Item
10:1 A B	 362442 (15T) 369844-1 (35T&14T)	 362442 (15T) 362434 (35T&14T)
12.5:1 A B	 362440-1 (10T) 369852-1 (25T&12T)	 362440-1 (10T) 362437 (25T&12T)
20:1 A B C D	Not Available	 362441 (11T) 362446 (42T&27T) 362444 (33T&14T) 362450-1 (46T)
25:1 A B	 362440-1 (10T) 369851-1 (50T&12T)	 362487-1 (10T) 362436 (50T&12T)
30:1 A B C D	 362441 (11T) 369847-1 (42T&12T) 364784 (44T&28T) 364838-1 (28T)	 362441 (11T) 362439 (42T&12T) 362400 (44T&28T) 362450-2 (28T)
60:1 A B C D	 362441 (11T) 369847-1 (42T&12T) 364786 (44T&14T) 364838-2 (46T)	 362441 (11T) 362439 (42T&12T) 362402 (44T&14T) 362450-1 (46T)

PRINT MOTOR (60 c.p.s.) **PARTS LIST**

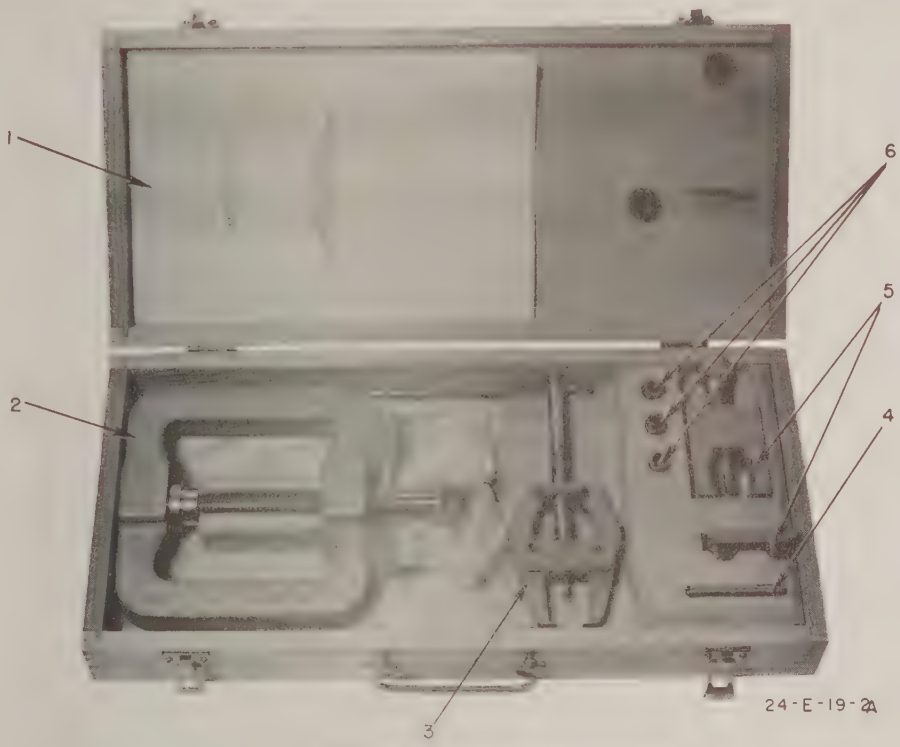


Figure 3. Tool kit and components

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
3				
	364950	complete tool kit		1
1	365568-1	case		1
2	365535	screw press		1
3	364402	puller for armature pinion and bearing		1
4	364399	pilot for inserting shaft post grease seal in gear housing		1
5	364407	puller for output pinion		1
6	364397-1	spacer for output shaft 362429		1
	364397-2	spacer for output shaft 362430		1
	364397-3	spacer for output shaft 362458		1

REPLACEMENT TIPS			
Part No.	Description	RSPL	Qty.
678759-1	puller & press	X	1
678759-2	puller	X	1
678759-3	press	X	1

INDICATING COMPONENT

PARTS LIST

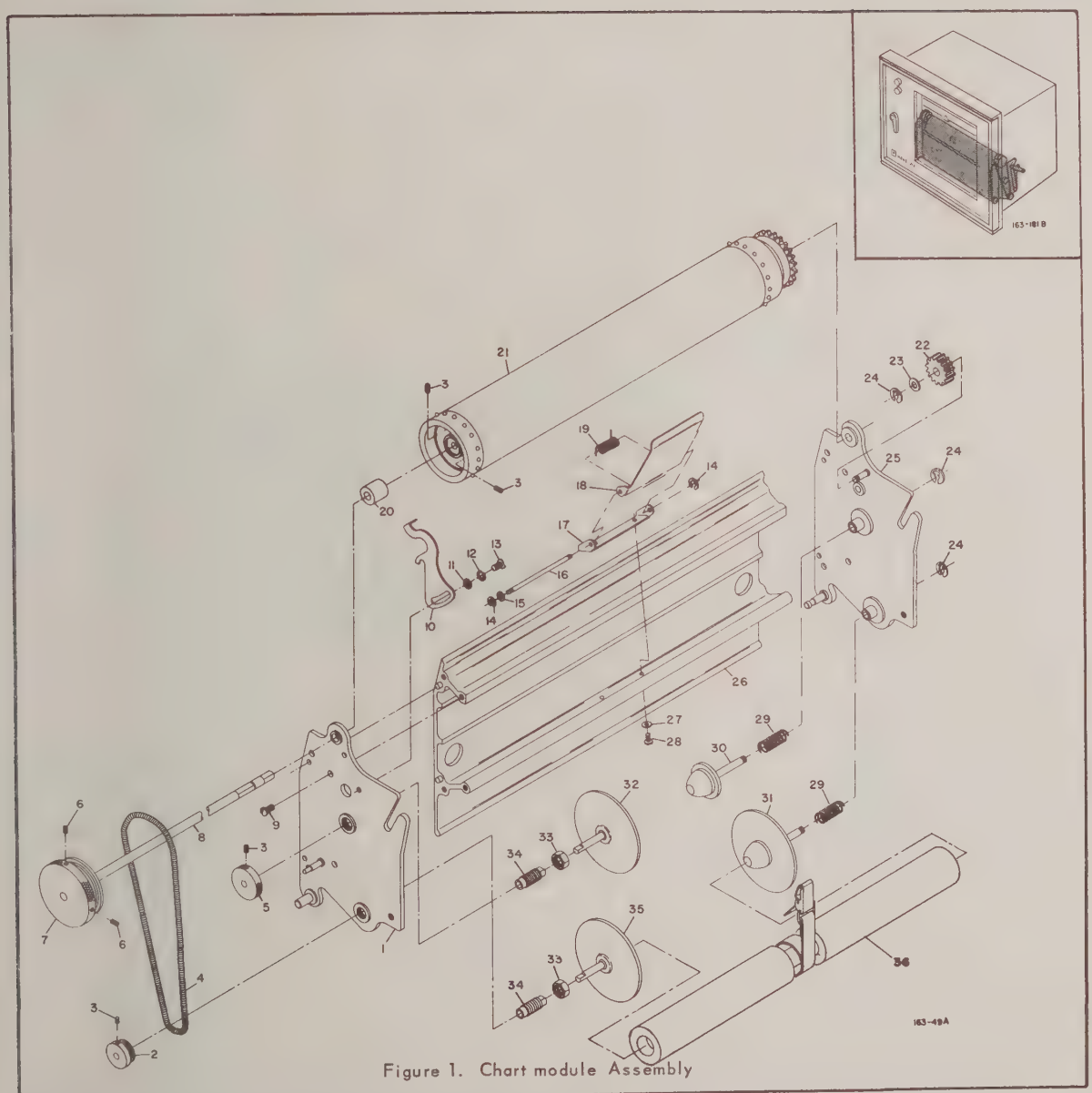


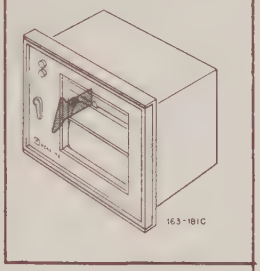
Figure 1. Chart module Assembly

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1	370400-1	chart module assembly		1
1	370350-1	side plate assembly - r.h.		1
2	372587-1	pulley knob		1
3	40958-3	setscrew		4
4	370374-1	spring	X	1
5	370438-1	knob		1
6	40958-2	setscrew		2
7	370364-1	knob		1
8	370455-1	shaft		1

Figure and Key No.	Part No	Description	Recommended Spare Parts	Quantity
9	5-806	screw - 8-32 binding hd. 3/8"		8
10	370379-1	pointer		1
11	364998	washer		1
12	917	lockwasher		1
13	8-804	screw - 8-32 fillister hd. 1/4"		1
14	79208	cotter		2
15	6885	washer		2
16	370378-1	shaft		1
17	370376-1	bracket		1
18	370375-1	plate		1
19	370377-1	spring		1
20	370363-1	spacer		1
21	370359-1	chart drum assembly		1
22	370365-1	idler gear (38T)		1
23	77249	washer		1
24	9748	cotter		3
25	370355-1	side plate assembly - l.h.		1
26	370408-1	chart plate		1
27	78196	lockwasher		2
28	5-604	screw - 6-32 binding hd. 1/4"		2
29	370445-1	spring		2
30	370431-2	supply holder assembly		1
31	370431-1	reroll holder assembly		1
32	372580-1	supply center assembly		1
33	75882	locknut		2
34	372588-1	bearing		2
35	372580-2	reroll center assembly		1
36	355556	chart saver reroll ass'y. (optional)		1

INDICATING COMPONENTS

PARTS LIST



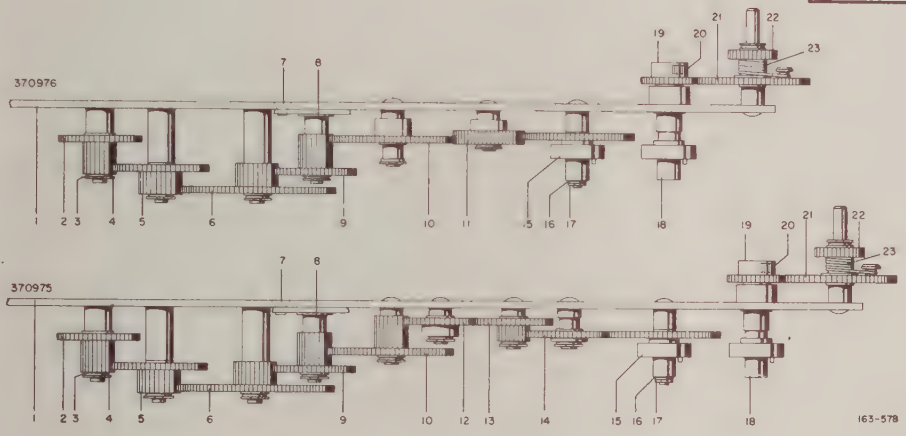


Figure 1. Hi-Speed Chart Drive.

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
		hi-speed chart drive assembly (see Table 1) component parts for above assembly (see Table 2)		1

TABLE 1
HI-SPEED CHART DRIVE ASSEMBLY

PART NUMBER	BASIC CHART SPEED FOR 60-CYCLE INSTRUMENTS MOTOR SPEED RPM			
	30	60	90	180
370975-1	1" min	2" min	-	6" min
370975-2	-	-	-	12" min
370975-3	1" hr	2" hr	-	6" hr
370975-4	-	-	-	12" hr
370976-1	10" min	20" min	30" min	60" min
370976-2	-	-	-	120" min
370976-3	10" hr	20" hr	30" hr	-

TABLE 2
GEAR ASSEMBLIES AND COMPONENT PARTS

Key No.	Part Number	Description	Used on						
			370975-1	370975-2	370975-3	370975-4	370976-1	370976-2	370976-3
1	370977-1	gear plate assembly	1	1	-	-	-	-	-
1	370977-2	gear plate assembly	-	-	-	-	1	1	-
1	370977-3	gear plate assembly	-	-	1	1	-	-	-
1	370977-4	gear plate assembly	-	-	-	-	-	-	1
2	370911-1	gear ass'y (20 & 52T)	-	-	1	1	-	-	1
3	77249	washer	5	5	9	9	3	3	7
4	9748	cotter	5	5	9	9	3	3	7
5	370914-1	gear ass'y (26 & 60T)	-	-	1	1	-	-	1
6	370914-2	gear ass'y (26 & 100T)	-	-	1	1	-	-	1
7	7-603	screw — 6-32 flat hd.	-	-	2	2	-	-	2
8	370916-1	stud assembly	-	-	1	1	-	-	1
9	370911-2	gear ass'y (20 & 52T)	-	-	1	1	-	-	1
10	370980-1	gear ass'y (20 & 80T)	1	1	1	1	-	-	-
10	370988-2	gear ass'y (80T)	-	-	-	-	1	1	1
11	370993-1	gear ass'y (44T)	-	-	-	-	1	1	1
12	370982-1	gear ass'y (44T)	1	1	1	1	-	-	-
13	370986-1	gear ass'y (20 & 50T)	1	1	1	1	-	-	-
14	370988-1	gear ass'y (52T)	1	1	1	1	-	-	-
15	370084-4	gear ass'y (72T)	1	1	1	1	1	1	1
16	42081	washer	1	1	1	1	1	1	1
17	7403	cotter	1	1	1	1	1	1	1
18	370991-1	hub & shaft assembly	1	1	1	1	1	1	1
19	370371-3	gear ass'y (54T)	-	1	-	1	-	1	-
19	370371-2	gear ass'y (36T)	1	-	1	-	1	-	1
20	40958-1	setscrew	1	1	1	1	1	1	1
21	372954-1	gear ass'y (72T)	1	-	1	-	1	-	1
21	372954-3	gear ass'y (54T)	-	1	-	1	-	1	-
22	372951-1	gear ass'y. (20T)	1	1	1	1	1	1	1
23	372959-1	spring	1	1	1	1	1	1	1

PEN CARRIAGE
SINGLE-PEN RECORDER
STD AND PUSH-PULL

PARTS LIST

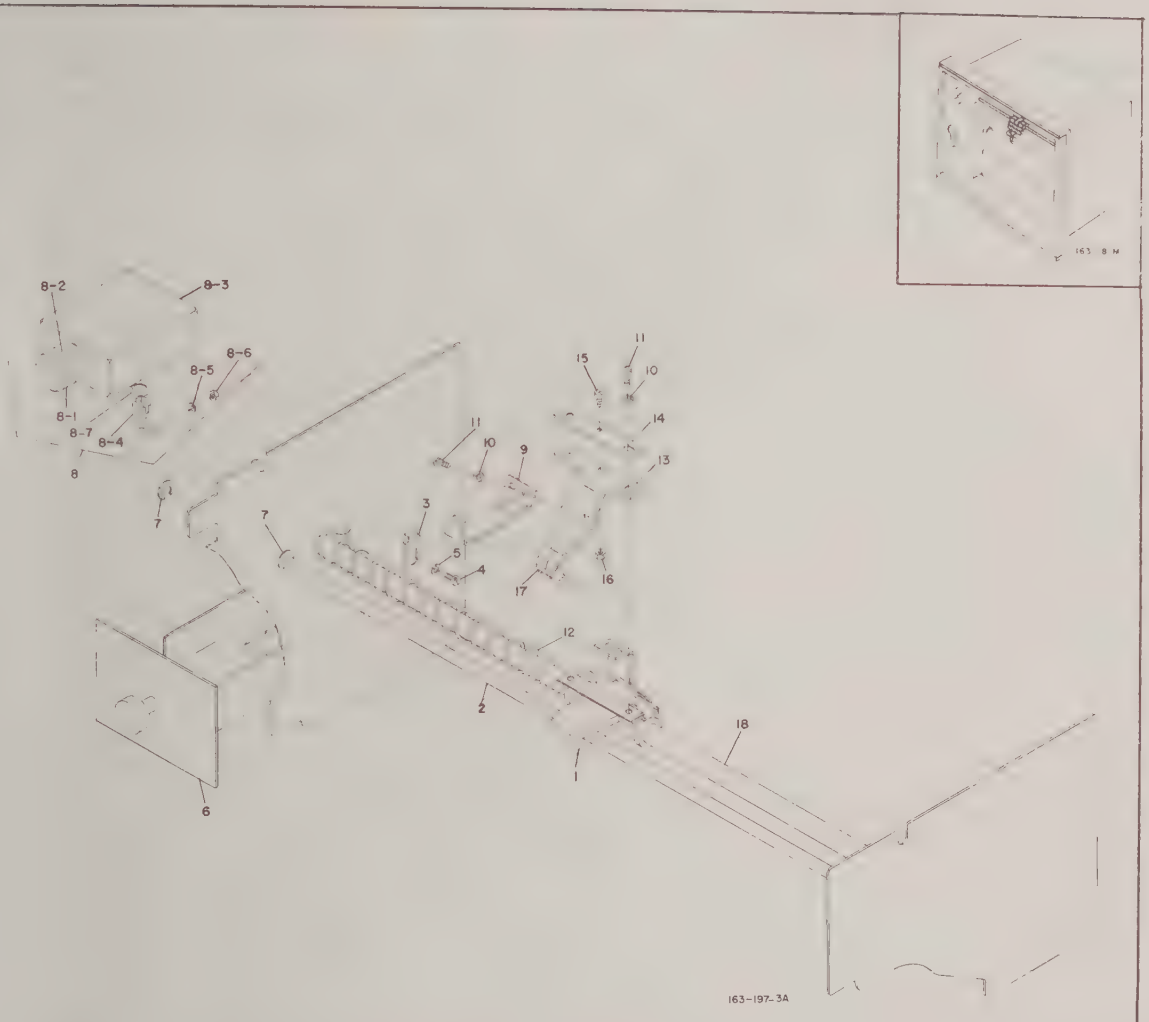


Figure 1. Pen Carriage Assembly

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
1				
	370638-1	pen carriage ass'y. (upper or #1 pen)		1
1	370600-1	carriage ass'y.		1
2	370575-1	shaft		1
	370579-1	shaft ass'y. (pen lifter - optional)		1
3	370564-1	clip		1
4	8-803	screw - 8-32 fillister hd. 3/16"		A.R.
5	76091	washer		A.R.
6	370639-1	ink drawer ass'y.		1
7	40032	cotters		4
8	370621-1	bottle ass'y.		1

Figure and Key No.	Part No.	Description	Recommended Spare Parts	Quantity
8-1	723357-1	cap		1
8-2	724301-1	plug		1
8-3	370602-1	ink bottle		1
8-4	370622-1	plug & tube ass'y.		1
8-5	4972	washer		1
8-6	4906	nut		1
8-7	354697-2	"O" ring	X	1
9	370599-1	pointer		1
10	360900-1	lockwasher		3
11	5-402	screw - 4-40 binding hd. 1/8"		3
12	370582-1	tubing	X	1
13	370597-1	arm ass'y.		1
14	370567-1	plate		1
15	5-204	screw - 2-56 binding hd. 1/4"		1
16	365885-3	nut		1
17	370553-1	pen ass'y.	X	1
18	370574-1	shaft		

TWO-SPEED GEAR REDUCTION UNIT

PARTS LIST

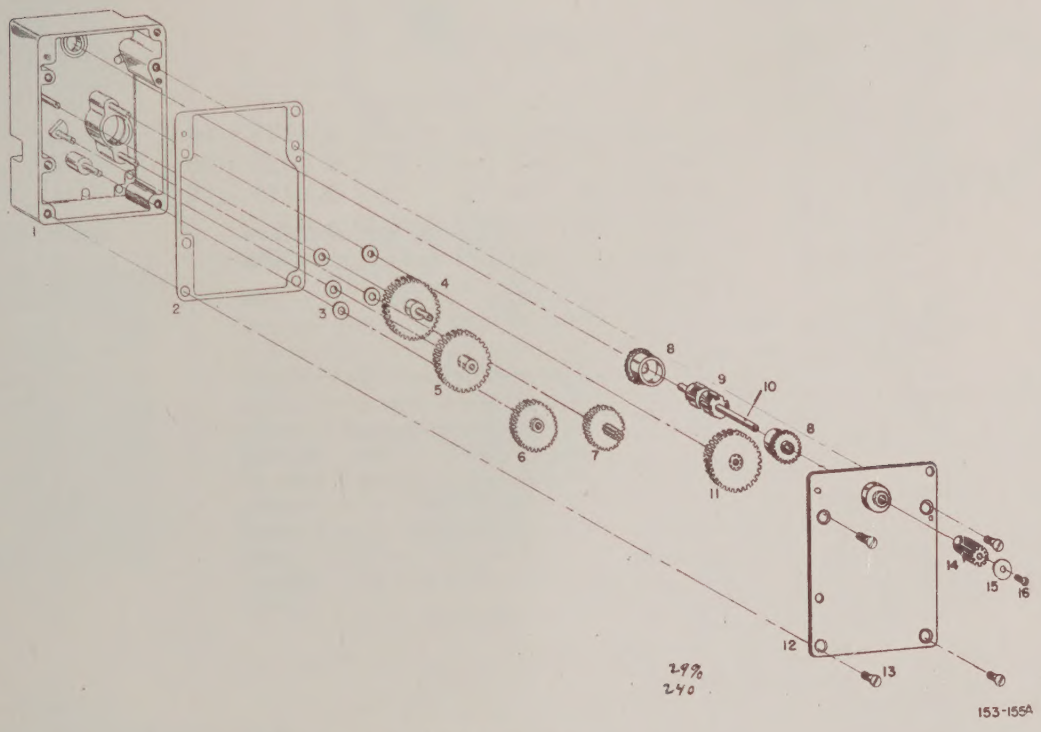
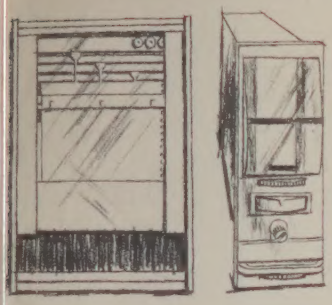


Figure 1. Two-speed gear reduction unit

KEY NO.	PART NO.	DESCRIPTION	QTY.
		gear box ass'y	1
	375788-508	3.33:1 ratio	
	365677-507	2:1 ratio	
	365678-501	6:1 ratio	
	365677-501	60:1 ratio	
	365677-502	30:1 ratio	
	365677-503	10:1 ratio	
1	365676-1	housing sub-ass'y	1
1	365676-2	housing sub-ass'y -(6:1)	1
2	365770-1	gasket	1
3	366568-1	thrust washer	5
4	366578-1	gear and hub ass'y 507	1
5	366655-1	pinion and gear ass'y (18 & 54T) 60:1, 30:1, 10:1	1
5	366655-2*	pinion and gear ass'y (18 & 54T)-6:1	1
5	372422-1*	pinion and gear (18 & 45T)-2:1	1
5	372422-2	pinion and gear (18 & 30T) -3.33:1	1
6	366661-1	gear ass'y (16T & 48%) - 60:1	1
6	366661-2	gear ass'y (16T & 40%) - 30:1	1
6	366661-3	gear ass'y (16T & 24T) - 10:1	1
6	372426-1	gear ass'y (12 & 25T) - 2:1	1
6	372429-3	gear ass'y (14 & 30T) - 3.33:1	1

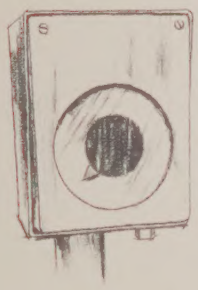
* 1 hour 20°PA, identified by #20 on gear
2 hour 14.50 PA, identified by #14 on gear

KEY NO.	PART NO.	DESCRIPTION	QTY.
7	366575-1	pinion and gear ass'y (12T & 40T) - 60:1	1
7	365671-1	pinion and gear ass'y (20T & 40T) - 30:1	1
7	366580-1	pinion and gear ass'y (18T & 40T) - 10:1	1
7	372429-1	pinion and gear (40 & 48T) - 2:1	1
7	372429-2	pinion and gear (40 & 30T) - 3.33:1	1
8	366573-1	gear and clutch housing (40T)	2
9	366574-1	clutch and shaft ass'y	1
10	356794-8	roll pin	1
11	366658-1	pinion and gear ass'y (26T & 52T)	1
12	365673-1	cover plate ass'y	1
13	70-805	screw - 8-32 flat hd. 5/16"	4
14		output pinion	1
	366570-1	ElectroniK 15 (20T)	
	370219	ElectroniK 16 (48T)	
15	74828	washer	1
15	689280-1	lockwasher	1
16	1-192	screw - 5-40 roundhd. 1/4"	1
		Not shown	
17	78406	3 point terminal block	1
18	78403-10	marker strip (J, K, L)	1
19	361908-1	arc suppressor	
		with chart switch	2
		without chart switch	1
20	369598-1	cable and switch assembly	1
21	359170	switch plate	1
22	355703	chart speed selector knob	1



ELECTRIC MINIATURE

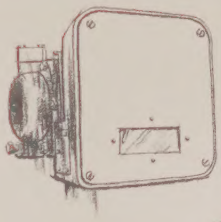
CurrentroniK instruments operate on the current balance principle and are particularly suitable for applications where you want remote indication or record of a variable. They are available as Vertical Scale Indicators, Deviation Controllers, Recorders and Recorder-Controllers, Trend Recorders plus a wide variety of accompanying *CurrentpaK* auxiliary devices. The *CurrentpaK* devices can be either surface mounted or back-of-instrument-mounted.

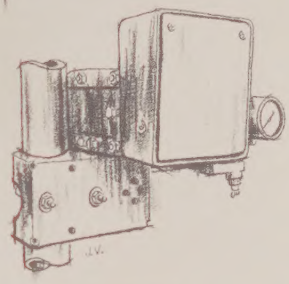


PRESSURE GAGES AND TRANSMITTERS

Pneumatic pressure transmitters measure process pressures ranging from 0-15 to 0-10,000 psi and transmit a 3-15 psi signal which varies in proportion to changes in the measured pressure. The transmitter can be supplied as a concentric scale indicator for local indication at point of measurement, or as a non-indicator.

Pressure gages are available as indicators, or as one, two, or three-pen recorders with pneumatic or electric control.





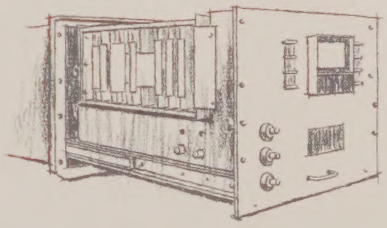
FLOW AND LIQUID LEVEL METERS

You can get any range in mechanical bellows type flow meter from 0-20 inches of water to 0-400 inches of water, can change ranges quickly by simply replacing a single-range spring assembly. Indicating Bellows Meter Models combining the characteristics of the bellows meter body with a rugged, easy-to-read 6-inch dial indicator and electric transmitters are available.

The Bellows Flow Transmitter or the Pneumatic Differential Pressure Transmitter ($\Delta P/P$) can be used in any open or closed-tank liquid level application, or flow application, to transmit a pneumatic signal from a field location.

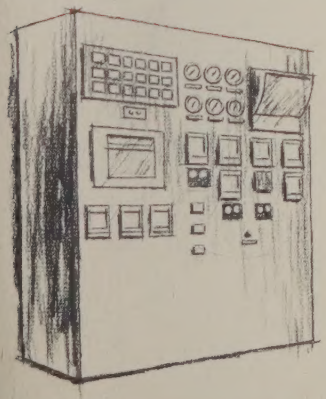
PNEUMATIC MINIATURE

PneumatiK Tel-O-Set instruments with or without control and with one or two pens are particularly suitable for applications where you want a remote indication or record of a variable, and where you want to conserve panel space. PVSI (Pneumatic Vertical Scale Indicating Instruments) are designed for maximum density mounting in process control or indication applications where small size and operator convenience are important requirements. An operator can glance at a bank of these indicators and quickly determine process conditions.



SPECIAL PURPOSE ANALOG COMPUTERS

Special Purpose analog computers are designed to operate continuously and reliably in typical industrial plant environment. Honeywell's analog computers are in use on a number of applications. For example, they are measuring mass flow, monitoring large quantities of electric power as a power demand computer, and maintaining correct coating weight as a weight-of-coat computer.

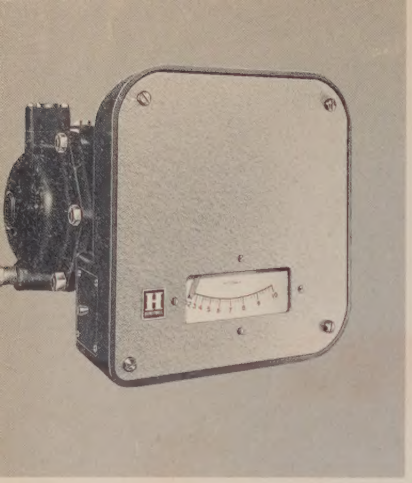


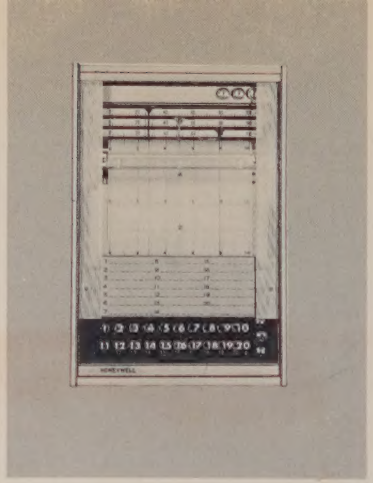
COMPLETE CONTROL CENTER FABRICATION

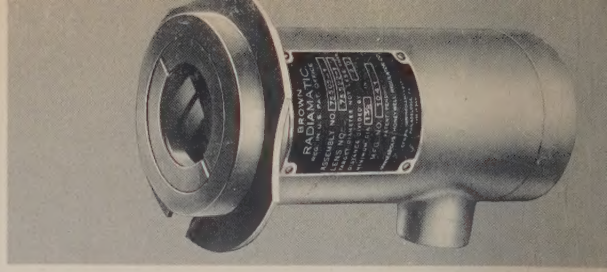
Honeywell offers a complete custom panel-building operation. From complex control instrumentation centers mounted in cubicles and panels, to consoles or relay racks, Honeywell's prime objectives are error-free operation and fast access for maintenance on all panel products.

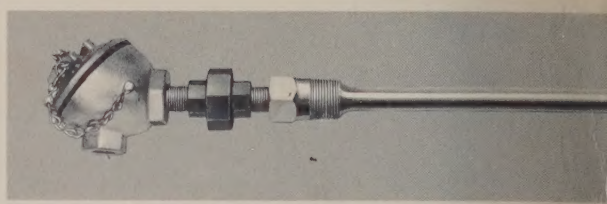
CONTRACT SERVICES

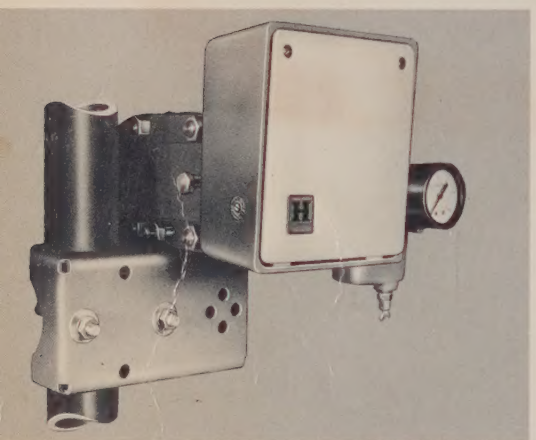
A typical instrumentation contract breaks down into two parts; a list of hardware, and the labor and materials necessary to install the system. Honeywell contract services can include: (1) help in designing the instrumentation system (2) supplying all needed equipment (3) installing and commissioning the equip ment (4) starting up the system and training operators (5) complete maintenance of the system for a fixed fee.

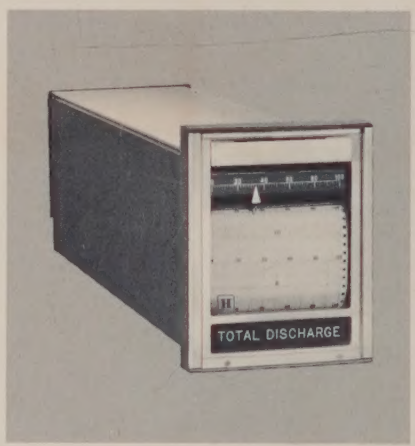


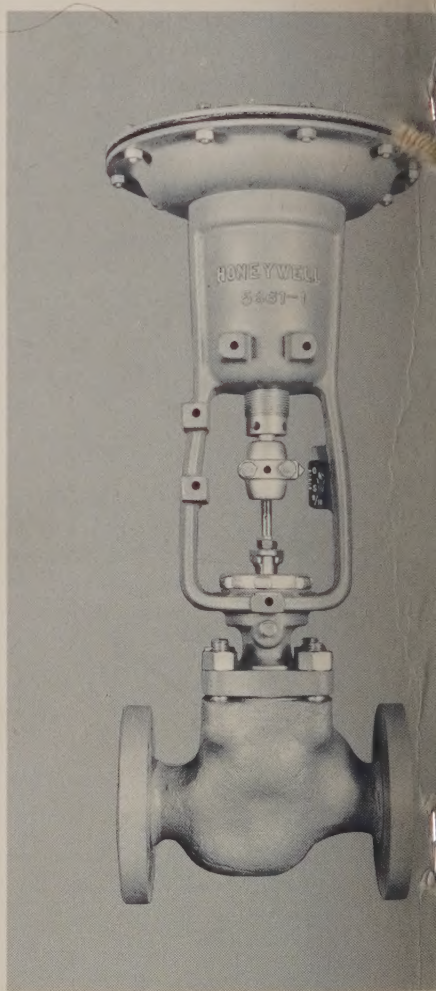


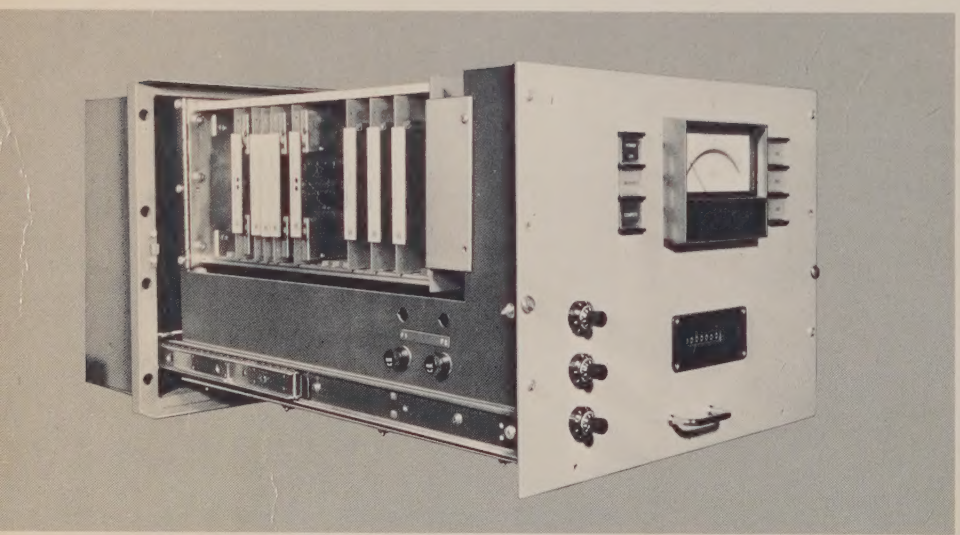


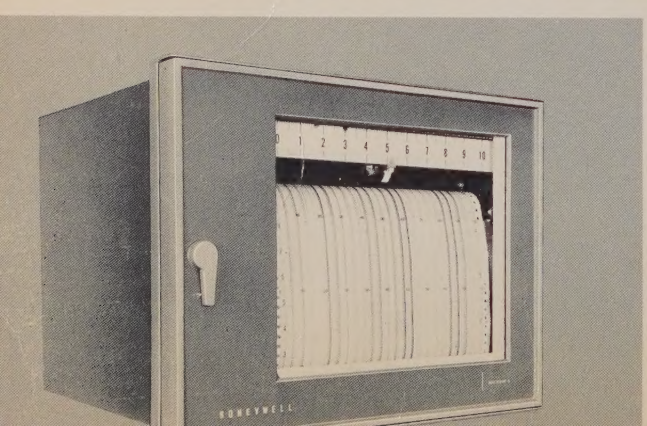


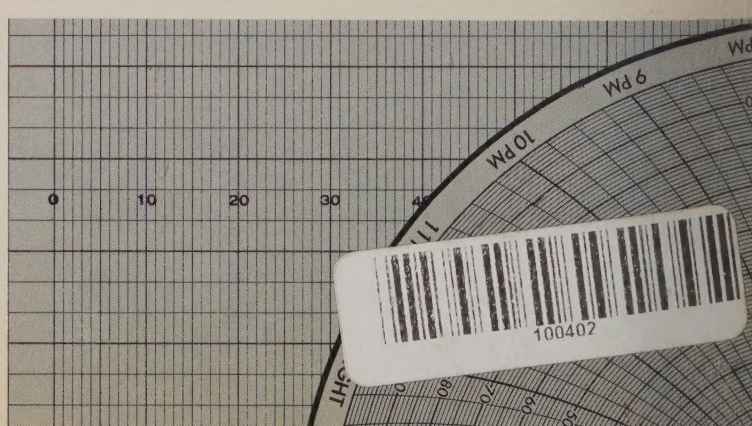



TOTAL DISCHARGE


HONEYWELL



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